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Engineering News-Record

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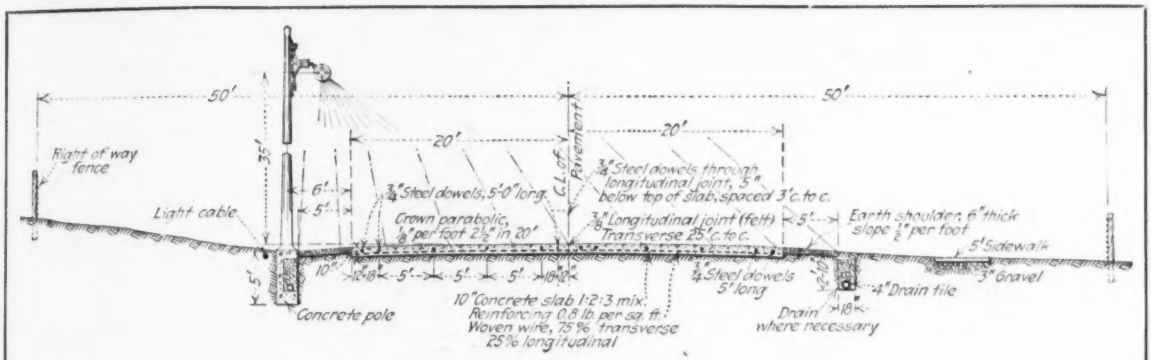

The Ideal Section of the Lincoln Highway

An exposition of the details and theory of its design by W. G. THOMPSON, *the consulting engineer on the section.*

DURABILITY, SAFETY, AESTHETICS

These are the main considerations behind the adopted design and specifications. Every detail of the Ideal Section embodies the composite judgment of a Technical Committee of 15 specialists in highway development, transport and landscape architecture, reinforced by the results of a questionnaire mailed to 4,600 engineers, educators and public officials.

Also in this issue: Fighting the Devil's Hole on the Mississippi; by A. L. Dabney—Estimating Reproduction Cost of Buildings for Valuation; by F. E. Barnes—Engineering Literature Section, Reviews of New Books.

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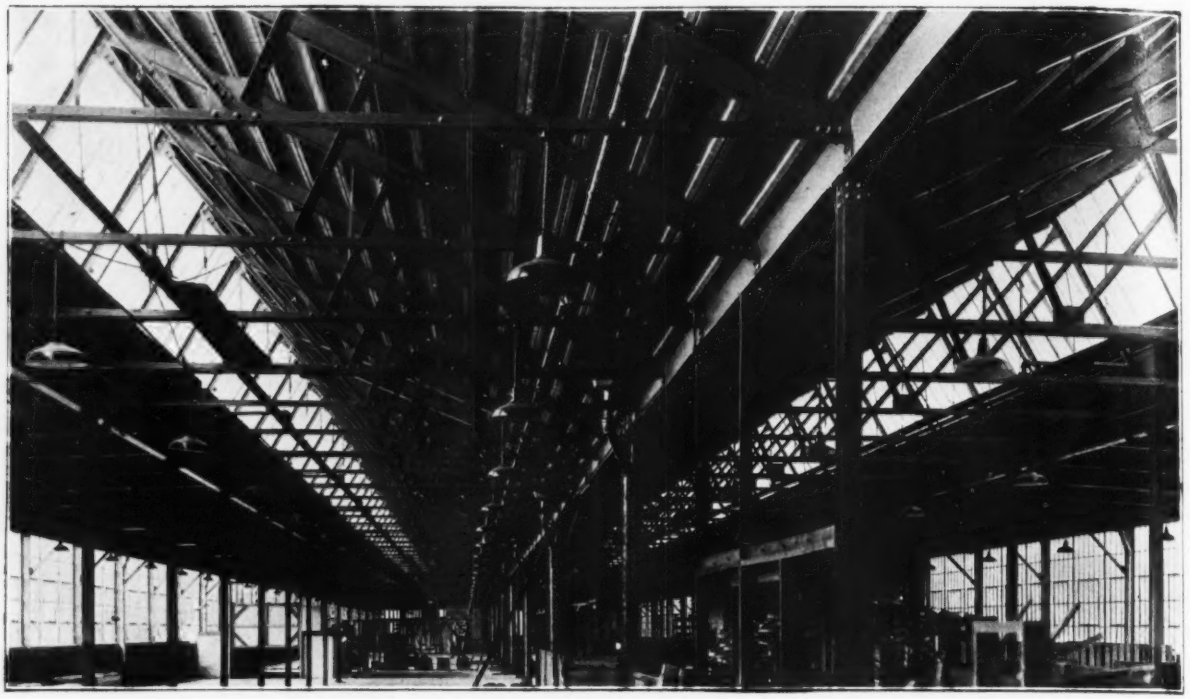

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 88 — NEW YORK, JUNE 15, 1922 — Number 24

Playing Up the Local Chapter

AS THE report in this week's news columns show, the Salt Lake meeting of the American Association was active if not overly well attended. Attendance, however, was by delegate and the chapter representation insured distributed expression of opinion. In fact, the emphasis on the chapter is the high spot of the report of the convention. No other technical society is paying so much attention to its chapter conduct or studying as closely how to reach the individual member and to make him both function for and appreciate the profession.

Getting More for the Railroad Dollar

TO DATE the Railroad Labor Board has authorized wage cuts to the amount of $110,000,000 and current comment foreshadows another cut that would bring the total to about $150,000,000. It would be a capital mistake to regard these sums as net savings. They simply represent so much more money available to spend on way, structures, and rolling-stock, in order that the railroad properties of the country may be enabled to play the part that will be theirs in the promised revival of business.

A Setback for Special Privilege

WERE it not for his consistent advocacy of special privilege for organized labor, it would be difficult to understand the fury with which Samuel Gompers assails the Coronado decision of the Supreme Court. But merely to recall his insistence that legislatures should not "interfere" with trades unions, however vicious their activities, will explain his resentment at their being held amenable to existing law. The decision lays down no new or startling doctrine. It simply applies to labor unions the elementary principle that the rights and privileges enjoyed under the law by organized labor carry with them a compensating obligation to respect the law and a responsibility for its violation. Decision by decision over a period of several years, the courts have been extending the mantle of fundamental law to cover these powerful organizations. The Coronado decision is but another step toward the abrogation of special privilege.

Warren Patents Lose

IN THE first legal contest involving claims by Warren Bros. Co., of Boston, of infringement of the Wallace bituminous paving patent, which it controls, the U. S. District Court in California has rendered a decision in favor of the defendants. The case was based upon work done for Fresno County, by Thompson Bros., contractors. Notwithstanding the fact that the decision is by a lower court and may be appealed, the outcome is noteworthy as the latest chapter to be added to the volume of paving-patent litigation in which the Warren interests have been engaged for many years. The expiration of their basic Bitulithic patent (No. 727,505) on May 5, 1920, placed the company in the position of relying upon other claims for the collection of royalties. They turned to the so-called Wallace patents, of which No. 959,976 is the principal one, covering a "composite" pavement in which a lower course of mixed bituminous concrete is covered, before compression, with a thin layer of finely graded bituminous top, the two layers then being compressed simultaneously to bond them into a compact, rigid mass, densest at the top. In the Fresno case infringement was claimed in spite of the fact that on all of the county's work the lower course was rolled prior to the application of the top course. The Warren interests, however, maintained that infringement existed if an upper course of pavement were laid upon a lower course while the latter was in a hot or plastic condition, irrespective of whether or not there was an intermediate rolling. Basing his opinion on a study of the prior art, Judge Bledsoe held that the Wallace patent claim could not thus be construed, inasmuch as two-course construction of this type had been covered in the original Warren patent already expired. In connection with this decision the reader may find it worth while to examine the article on the status of the Warren patents published in *Engineering News-Record* of Dec. 15, 1921, p. 969. Pending the outcome of an appeal it would be premature to generalize upon the effect of the Fresno decision in other localities. The result does indicate, however, that under such specifications as governed the California work, the Warren company's right to royalties under the Wallace patent is open to question.

Engineers and City Planning

ONE of the speakers at last week's City Planning Conference blamed engineers for not having introduced city planning long ago. The same criticism was voiced privately by another person at the conference who said that Cincinnati has had city engineers for 125 years but no one of them ever made a plan for the city. Both these critics were lawyers—men who draw our city charters and define the powers and duties of city engineers. Why did not the lawyers provide for city planning in municipal charters decades ago and entrust the work to the city engineers? Even now, after twenty years of city planning agitation in America, only a few city councils stand ready to back city planning by enabling ordinances and appropriations. Until recently, engineers have worked on this or on that element of the city plan—such as water-works, sewers, main thoroughfares—because the city fathers think and work piecemeal instead of on a comprehensive and co-ordinated city plan. Engineers have been present increasingly at the various city planning conferences and were prominent last week—presenting two of the leading papers, abstracted elsewhere in this issue. That engineers might have done more real city planning

in the past, ought to be doing more now and to be preparing for still more in the future is undeniable. Some 10 to 15 per cent of the total registration of over two hundred at the conference last week were engineers. The number hereafter should be materially increased, as new city planning boards are created and old and new boards are provided with engineering staffs, as is becoming increasingly common.

An Object-Lesson Road

IN SPITE of the name it bears, the Ideal Section of the Lincoln Highway, the design of which is discussed in detail by Mr. Thompson in this issue, is not offered by its proponents as the ultimate in highway development. Its purpose is, frankly, educational—an object-lesson road. Representing the composite judgment of a committee of fifteen technical specialists, every detail of the design has a reason behind it. It is in the study of these reasons, as Mr. Thompson gives them, and the weighing of them with regard to local conditions in every case that the highway engineer can benefit most. While the paved width of the Ideal Section is 40 ft., it would bankrupt most states if they proceeded on the policy that all trunk-line roads now should have an equal traffic-carrying capacity. The lesson of the Lincoln design of paved roadways is that widths should be suitable not merely for carrying the daily flow of vehicles, but also for minimizing accidents. A study of the ideal design should impress upon engineers again the need for safety, particularly at curves. Then, too, there is the feature, greatly neglected in American practice, of beautifying the roadside by means of shrubbery and trees. The ideal design stresses this detail. From the engineering point of view the Ideal Section of the Lincoln Highway is most valuable not as a model to be copied blindly, but rather as a means of making highway engineers think and of suggesting features which should be incorporated where local conditions make them desirable.

Acts of God?

MORE bridges are destroyed annually by flood washout than fail or are removed through any other cause. Current months have made a large addition to the record, with many washouts during the spring months, culminating in the loss of a 300-ft. steel span in Texas, and more recently the destruction of numbers of small bridges by summer-storm floods. Such facts do not accord with the idea of a permanent transportation system. What is at fault, Are bridge washouts unpreventable accidents, so-called "Acts of God," or are they the result of bad engineering? The answer lies with the engineer, but he must give heed to the public's viewpoint on the subject. The engineer knows that flood action is capricious and that the construction of a foundation proof against scour is very costly, in many cases far beyond reason. In consequence he is inclined to limit his foundation cost to an ordinary figure and, if the structure is washed out, to call its destruction unpreventable. But the public expects bridges to survive; it knows that bridges are built by engineers, and knows that when a bridge washes out it is the engineer's handiwork that has failed. It is imperative that these divergent views be harmonized. This must be accomplished by a change in the engineer's view, and acceptance of the principle that bridges should be built to resist floods. If we are to hold to the attitude of the past, and look with equanimity on wholesale destruction of bridges by washout, then it is a question whether we are not designing wastefully, by putting more money into superstructures than the vulnerability of the foundation warrants. A sound basis for progressive thinking on bridge design is demanded. The first need is to determine what degree of natural stress represents reasonably possible service, and how great must be the storm or how high the flood to constitute an "Act of God." When this is done and when the practice is established of building bridges to last indefinitely, our permanent transportation system will be nearer realization than now.

Ford's Offer Revised

HENRY FORD'S Muscle Shoals offer as embodied in the majority bill of the Committee on Military Affairs is materially changed from his original proposal in two particulars. The bill makes it a requirement that the Ford company manufacture, and sell at a profit of not more than 8 per cent, fertilizers with nitrogen content of at least 40,000 tons of fixed nitrogen, which would be a very substantial proportion of the fertilizer consumption today. This provision Mr. Ford agrees to. The bill, however, does not give away the Gorgas steam plant and at last reports the Detroit manufacturer continued to hold out for that property as a necessary part of his offer, although it is inconceivable that he will continue to do so if he really wants Muscle Shoals. He shows characteristic knowledge of human nature when he gives in on the fertilizer matter. On every count but that the offer of the Alabama Power Co., so slightingly dismissed by the congressional committee, is superior to that of Ford. But Henry Ford knows that Congress, especially now that farmers' votes are needed, wants to make a gesture toward cheap fertilizer. That the government is but poorly compensated for the Muscle Shoals investment and that the 100-year lease offered is an invidious violation of the water-power act are made secondary to the promise to make fertilizer, though there is no promise in the offer to sell it any cheaper than any other fertilizer, unless the manufacturing costs turn out to be very low.

What Are Navigable Waters?

EVER since Congress in 1920 passed the Federal Water Power Act it has been apparent that sooner or later the Supreme Court would have to pass on the constitutionality of the definition of "navigable waters" in that act and on all the powers under federal control that definition prescribed. In granting permission to the State of New York to bring the law to test the court has now insured a fairly early settlement of the issue. The decision when rendered will rank as one of the most important of constitutional interpretations and will have a farreaching effect upon power development and the economic life of the country.

One little sentence in the Constitution, "The Congress shall have power . . . to regulate commerce . . . among the several states," is involved. By direct application of this power the whole economic course of transportation has been changed in the past three decades, and by its implication millions have been expended in the development for commerce and transportation of streams actually or potentially navigable. Through a long line of court decisions this latter power

of the federal government to control intrastate waters has been so well established that there is no possibility of its being contravened. Extension of the federal power to flood control, too, has been steady and for the most part unopposed, though the exact wording of the Constitution has to be severely strained to permit this construction. With the development of electric transmission, however, a new phase of waterway use arose, one which could not have been conceived by the authors of the Constitution and which is not directly covered by that document. This is the use of water for power. Acting under the interstate commerce clause of the Constitution, Congress in the Federal Water Power Act assumed control of so-called navigable waters for power use and it defined navigable waters as those of which any part is "used or suitable for use for the transportation of persons or property in interstate or foreign commerce."

By broad interpretation this might include all useful waters in the country, for practically any stream of potential power value can somewhere along its course float a log or a rowboat—"property," it will be noted, "in interstate or foreign commerce." Is so broad a federal supervision permitted by the Constitution? Several of the states deny it and New York is bringing the case to the highest authority. Its settlement will not only clear up an ambiguity in the Federal Water Power Act which is worrying the public officials of many of the states and the promoters of many water-power projects but it will be another milestone in the century-old states rights dispute.

Why Engineers Stay Home

FROM the news we learn that in many quarters folks are giving a thought to the waste chargeable to guff. An unusually succinct budget report by the British Chancellor of the Exchequer won, even from a political opponent, commendation for its merciful brevity. The Quebec Board of Trade forbids its members to talk in its meetings for more than three minutes unless they have something to say, in which event they are allowed ten minutes in which to say it. A fledgling senator has recorded his bewilderment as senatorial prolixity and has dared to predict that some day senators will be required to speak to the point. On every hand we find a desire to impose an embargo on twaddle.

All this, unfortunately, rouses memories of technical society meetings we all have attended. Today, most technical societies are seeking to increase their usefulness to their members. We suspect that no other one thing they might do could accomplish more to that end than would the elimination of the interminable and oft-times irrelevant discussions that drag out so many technical meetings until all hours. In some of the large cities many members live out of town and must catch certain trains. Frequently, these men, who have gone to the trouble and sometimes incurred the expense of staying in town for the meeting, must hurry off in the middle of the discussion because one or two have been permitted to fritter away precious minutes on airy nothings. Others, who live in town, may have few spare evenings and resent the dissipation of the time they are willing to devote to their technical societies.

The genus *time-waster* includes several species. There is, for example, the chap who cannot stick to the point and wanders off into byways that to him may be most interesting but that contribute nothing to the subject in hand. Sometimes the digression takes the form of an alleged funny story of vague point and doubtful application. Most engineers, to be sure, have a sense of humor and are glad to have a technical discussion illumined by an appropriate anecdote; but few can sit patiently and listen to ancient and inappropriate yarns just because the speaker happened to hear them only that afternoon. So far as genuine discussion is concerned, a presiding officer of tact and resource can do much to keep it to the point; but suppression of the would-be humorist is more properly the task of discerning, heartless, and courageous personal friends.

Much of the rambling—most of it, probably—results from a lack of clear-cut purpose in the speaker. Many do not prepare in advance, even in their minds, what they propose to contribute to the discussion. Sometimes, of course, ideas are suggested by what another has said; but it would seem that from the very nature of such cases the comment would be to the point. Digression of this sort is in general unconscious and can easily be eliminated if speakers will formulate clearly in their minds just what they want to say, get up and say it, and when they have said it, sit down. It takes a good man to know how to talk; it takes a better one to know when to stop. More pernicious than all this, however, is the case of the perennial discussor who seems to fear that unless he talks on every subject that comes up he will be overlooked and forgotten. Much time is wasted by those who feel bound to talk, and who, if they know nothing about the subject under discussion will gladly oblige with a dissertation on the nearest thing to it that they do know something about. To be seen and heard seems to be their chief object.

A third species is the hobby-rider. Amazing it is, how deftly this specimen can hitch his steed to any vehicle that may happen to be traveling the highway of technical intercourse. Whatever its nature, we find it serenely bobbing its way through every discussion its master attends, be the subject anything from microscopical investigation of steel fractures to the newest theory for valuing a public utility.

While the sheer waste of time and energy caused by this sort of thing is regrettable, a deplorable by-product is the exclusion by the time-wasters of men who really could say something. Although our technical gardens may be overrun with ramblers, sunflowers, and forget-me-nots, there will still be found lurking in obscure corners violets of true worth that blush unseen under the competition of the more hardy perennials. We believe that if conciseness were more generally the vogue in technical discussions and loquacity were more openly frowned on as being decidedly unsportsmanlike and in bad form, many of these younger and more modest—and often more competent—men would be encouraged to say their say. To be sure, much of the fault is their own for not tossing their hats into the ring, but under the circumstances their reticence is understandable.

While calling attention to this particular evil we are not forgetting that some societies labor under the opposite difficulty—a dearth of discussion that leaves many meetings fruitless and uninspiring. But that is another ailment which calls for different treatment.

Engineers have talked much about elimination of waste. We suggest that here is a chance for them to do a job right in their own household.

Design Features of Lincoln Highway "Ideal Section"

Technical Committee Has Planned Object-Lesson Route in Every Detail of Which Best Highway Engineering Practice Will Be Embodied

By W. G. Thompson
Consulting Highway Engineer,
Ideal Section, Lincoln Highway Association and Former State Highway Engineer of New Jersey

During 1919 and 1920, it became evident to the officials of the Lincoln Highway Association that the need for stimulating interest in highway development no longer existed, because of the then country-wide demand for more and better highways and the unprecedented provision of funds for their construction. Their thought then turned to comprehensive specifications and more durable construction, the need for insuring safety and convenience to highway users, and the protection and amplification, where possible, of the existing natural beauties of the road sides. Thus, the Ideal Section of the Lincoln Highway, a 1½-mile length between Dyer and Schererville, Ind., 32 miles south of Chicago, was conceived.

SITE IN INDIANA FOR IDEAL SECTION

Its proponents do not consider it the ultimate in highway development, nor do they set it up as a pattern to be minutely followed by all authorities. Rather, they submit it as a guide, hoping that the general principles outlined may be adopted and improved upon when improvement of main routes of heavy travel is being considered. Criticism of the Ideal Section is invited and expected.

In order to avail itself of ideas from every section of the country, the association mailed 4,600 questionnaires to highway engineers in public employ and to college professors of highway engineering, requesting suggestions as to specifications and design. A summary of the replies was used as the basis of discussion by a technical committee of highway engineers and authorities, appointed by the association to serve without pay in determining the essentials of the general specifications and requirements. At meetings of this committee held in New York in December, 1920, and in Chicago in February, 1921, discussion of the problem covered 18 principal points, which, as briefly enumerated below, were adopted for the guidance of the consulting highway engineer and the consulting landscape architect appointed by the association to prepare the working design and specifications.

1. The standard width of right-of-way for the Ideal Section shall be 100 ft.: Highway authorities must anticipate future requirements by the securing of options on adequate rights-of-way in advance of the time the additional right-of-way widths may be necessary, and thus, while not hampering abutting property owners in the use of the additional right-of-way, still make economic provision for its future use.

2. The specifications shall be predicated upon an average traffic of 15,000 passenger automobiles per 24-hr. day, traveling at a speed of 35 miles per hour and 5,000 motor trucks per 24-hr. day, traveling at an average speed of 10 miles per hour: The width of paving shall be 40 ft., laid in one continuous slab in the center of the right-of-way, to allow four lanes of travel on the metal.

3. The specifications shall be predicated on the ultimate statutory regulation of motor-truck design, limiting the superimposed load to 800 lb. per inch of width of tire actually in contact with the road surface and to 8,000 lb. per rear wheel: Assuming the total rear axle load at 16,000 lb. as 75 per cent of the total gross load, then the total permissible load per truck would be 21,333 lb., which is somewhat under the maximum load now permitted by statute in several states.

4. The drainage shall consist of submerged drain tile and catch basins.

5. The Ideal Section shall be constructed of concrete, 10 in. thick, of uniform section, with reinforcing steel embedded: Reinforcing steel shall be considered as ties to hold the slabs together in case of cracking and to prevent the widening of cracks. It is not to be considered as reinforcing steel in the sense that steel is used in reinforcing a concrete building. Approximately 80 lb. per 100 sq.ft. of steel mesh or rods shall be placed near the top of the slab.

6. The design shall require the placing of tie steel across the longitudinal and transverse joints.

7. Earth shoulders shall be provided on each side of the concrete.

8. The Ideal Section shall be lighted.

9. No curves shall have a radius of less than 1,000 ft. and all curves shall be superelevated for a speed of 35 miles per hour. Wherever reasonably possible, curves shall be eliminated.

10. A foot-path shall be provided for pedestrians.

11. The Ideal Section shall be equipped with guard and warning signs and all embankments protected by guard rails.

12. All crossings at grade shall be eliminated.

13. All wires shall be placed underground: Item 13 was later qualified as follows: While the technical committee understands that at the present time there are economical and technical objections against placing wires underground, it recognizes that this practice may become possible in the future, and recommends that they be so placed when it becomes feasible and prac-

ticable. Further, it urges research work along this line.

14. All advertising signs shall be prohibited along the right-of-way and all signs of direction or distance, except those placed or authorized by proper state authority, shall be prohibited.

15. Obstructions to vision at intersecting roads for a distance of at least 500 ft. each way from the intersection shall, in so far as practicable, be removed.

16. All distance marking should originate at the municipal headquarters of any town or city.

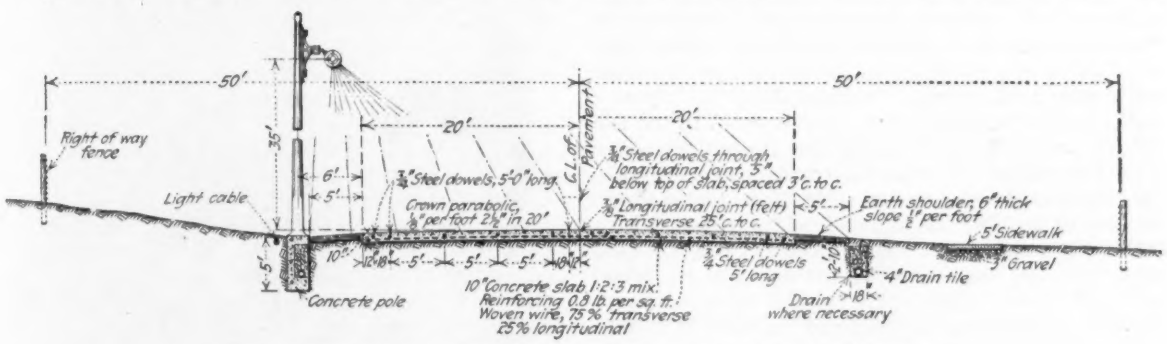
17. Neither the Ideal Section nor any other road should be built without provision for adequate, intelligent, continuous and prompt maintenance.

18. Comfort stations, park sites and ideal camp-site facilities are recommended.

A brief presentation of reasons for adoption of the above principal features follows:

1. Width of Right-of-Way—Especially for those highways between great cities obviously destined to become heavily traveled during coming generations, measures should now be taken to prevent encroachment and provide for additional pavement width as traffic pass a given point in single file; therefore, a two-traffic-lane road can easily pass 1,000 to 1,500 vehicles per hour, and during rush hours may handle double that number.

If economic reasons alone are to govern highway design, provision for four lanes of traffic, as in the proposed Ideal Section, is indefensible. However, in the death-registration area of the United States 9,000 persons were killed in motor accidents in 1920, a decided increase over any previous year. Many of those killed were pedestrians in cities, and many deaths were due to causes other than narrow pavements, but in the aggregate they demand that we consider the future, and its inevitable increase in the number of vehicles, particularly motor trucks, which, due to their low speed, will largely affect the traffic capacity and consequently the safety of the two-lane highway, unless provision be made to minimize their interference with high-speed vehicles. In many localities the traffic problem is not so much due to the high-speed driver, as it is to the interference by the cautious, inexperienced, slow drivers, and the slower motor trucks holding tenaciously



DESIGN DETAILS ADOPTED FOR IDEAL SECTION; LINCOLN HIGHWAY

demands. In providing for a 100-ft. right-of-way, and the further provision of securing options on 12½ ft. additional on each side, the technical committee had in mind not only the future utilitarian development, but possible æsthetic development as well. The property required, additional to that on the existing right-of-way, will be purchased by the Lincoln Highway Association and deeded to the State of Indiana.

2. Pavement Width—Opinions on width differ widely. Many contend that after traffic reaches a certain density parallel highways should be provided. However, vehicles usually follow a certain road and for many years attempts to divert traffic to parallel highways, for any reason outside the owner's volition, will meet with resistance from highway users. In future design pavement width will continue to be a matter subject to local determination.

A. N. Johnson, dean of the Engineering College, University of Maryland, gave in the June 9, 1921, issue of *Engineering News-Record*, p. 989, an analysis of methods for determining pavement widths. His conclusions, based upon careful observations of traffic covering several months on the Baltimore-Washington road, are that "highway plans contemplating an extended system of highways of greater width than is required for two lanes of traffic are extravagant and have no economic justification." This he predicates upon the fact that with a 25-mile speed and 132-ft. center to center spacing, 1,000 vehicles per hour can to the center of the present two-lane road. Collision, ditching, overturning, injury and death, frequently result from attempts to pass these vehicles on narrow roads.

In its discussion of this phase of the subject the committee considered, not especially the problems of today, but tried to visualize conditions as they will exist 20 years hence. If no motor trucks were to be considered the committee would undoubtedly have agreed on a two-, or at most, a three-lane design. There was no dissent to the proposition that separation of trucks and passenger vehicles, particularly between large cities, will be desirable in future design whenever feasible. This decision is based principally on the fact that human safety and convenience should be predominating influences in future design. Who can truthfully say there is recreational value, or anything but constant danger and nervous strain, in driving over our present two-lane highways anywhere within 50 miles of our large cities on holidays?

Economic considerations must always govern our highway policies, but the motor vehicle is fast reaching a place in the life of our people where economic policies will increasingly be tempered and influenced by demand for greater freedom from restraint, coupled with safety, than is now possible or practicable on our two-lane highways. *In the last analysis, human safety is of paramount importance, and should be subordinated to no other element or consideration in designs for engineering works.*

3. Truck Loadings—Wide differences of opinion have thus far prevented adoption of a common standard of maximum vehicle loadings, though the matter is now before many legislatures with fair prospect of general adoption, by statute, of not to exceed 28,000 lb. gross load, with not to exceed 75 per cent of the load on the rear axle. Realizing the futility of hoping for an early agreement on this subject the committee arbitrarily predicated the pavement design upon a maximum gross loading of 8,000 lb. per rear wheel, limiting the superimposed load to 800 lb. per inch of tire width.

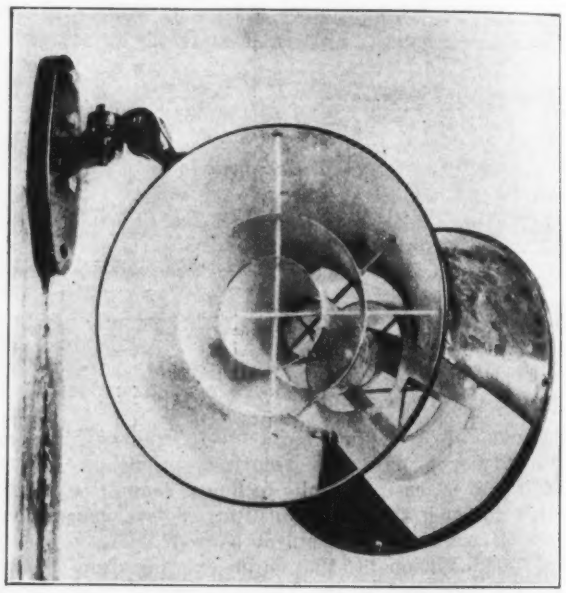
Subfoundation conditions at the proposed site in Lake County, Indiana, were known to be good and of uniformly high supporting value, and although it is admitted that the 10-in. slab thickness was arbitrarily decided upon, that decision is supported by the results from subsequent tests conducted by the U. S. Bureau of Public Roads at Arlington, Va., and described by C. A. Hogentogler (see *Engineering News-Record*, Dec. 8, 1921, p. 944). The tests showed that, as representing the average relation of thickness to impact resistance, the 10-in. slab of 1:1½:3 unreinforced concrete on a good subfoundation will resist single-wheel impact of 44,000 lb., at least until permanent subgrade deformation occurs. Granting a uniformly smooth pavement surface, a uniformly resistant subfoundation and uniformly good, unbroken vehicle tires, this figure is well above any impact force to be expected in the near future, especially considering the increasing use of pneumatic tires. Because of the conditions under which they were conducted, the tests, Mr. Hogentogler admits, are not to be taken as infallible guides to design. The technical committee of the Lincoln Highway Association, however, feels that in the absence of definite information the results of the bureau's tests justify the adoption of the above loadings and the 10-in. slab thickness. Addition of metal reinforcement and dowel bars across the joints will measurably increase the above-mentioned impact resistance, which is given for unreinforced slabs.

4. Drainage—The committee emphasizes the fact that subfoundation drainage is the first and predominating requisite to the success of any type of pavement. For safety reasons no open drainage ditches are to be permitted immediately adjacent to the roadway. Sufficient right-of-way is provided to enable placing them at a distance. Where the topography precludes this practice, catch-basins leading to pipes under the road or to covered drains will carry off surface water. Wherever necessary trenches, 4 ft. deep, with bottom tile and backfilled with coarse stone will be placed to intercept and carry off subsurface water.

One 30-ft. span, of reinforced-concrete, flat-slab bridge is included in the Ideal Section construction. It will have 40 ft., clear of vehicular roadway, and 5-ft. sidewalks. A strong parapet wall of simple design will be placed outside the sidewalks. Unusual care will be taken to compact the approach backfill. In order to minimize cracks due to possible settlement at the approaches to the bridge floor reinforced pavement approach slabs 15 ft. long will be laid to act as beams with their bridge ends resting on the abutment, and outer ends on the subfoundation. This method will minimize the effect of impact on the bridge floor slab, the destructive effect of which is so noticeable where breaks in the grade exist between the approach slab and the bridge floor.

5. Type of Pavement—The technical committee unanimously decided that the pavement should be one-course portland cement concrete, 1:2:3 mixture, of 10 in. uniform thickness on a crowned subfoundation with reinforcing metal embedded. It is not intended to convey the idea that concrete is considered the ideal pavement. We probably shall never attain that desideratum. The committee considers concrete the least expensive of the several more durable pavements now in use; if properly laid it can be used for many years as a pavement, and if its surface ever wears so that it is undesirable as a riding surface, it may be resurfaced with concrete, asphalt or brick. This practice has successfully been demonstrated.

It is generally admitted that other types of pavement for main highways should have a concrete base to insure the integrity of the surface, whatever the type. The initial cost of the concrete type, as thus far developed, being lower than that of any other type of surfacing on a concrete base, plus its comparatively low maintenance cost, plus its freedom from slipperiness in wet weather, and smooth riding qualities (when properly finished) gave it the preference in this selection.



BRACKET TYPE SERIES HIGHWAY LIGHTING UNIT

Little is definitely known of the causes of cracking in concrete-pavement slabs, or rather, definite means of prevention under any and all conditions are unknown. Recognizing this fact, a majority of the committee favored the placing of reinforcing metal to assist in holding together the cracked sections, and to prevent widening of cracks, which are readily repaired by filling with bitumen. Reinforcing metal will consist of steel mesh or rods. About 80 lb. per hundred square feet will be placed 3 in. below the top of the slab; ¾-in. steel bars, 5 ft. long, will be placed across the longitudinal joint, about 3 ft. center to center, to assist in preventing slab edges from rising above each other and to prevent possible widening of the longitudinal joint. Dowels to assist in preventing slab movement will be placed across transverse joints, which will be spaced at 75-ft. intervals.

7. Shoulders—Five-foot shoulders of earth are pro-

vided. These will be thoroughly compacted and a layer of good top-soil placed on them to be later seeded to grass. These will enable occasional use by vehicles without danger of injury. It is believed the 40-ft. width of pavement makes more durable shoulders unnecessary and that the grass or sod will minimize the unnecessary use and wear of the shoulders by vehicles. This has successfully been demonstrated in many places.

8. Lighting—The lighting of highways, except in the vicinity of cities, will continue to be a debatable question. Much of the objection to the lighting of interurban highways was, and still is, due to improper and inadequate lighting systems, where open lamps throw the glare into the drivers eyes and the type and position of reflectors cause the illumination of the fields alongside the road instead of confining it to the pavement proper. Given a uniform diffusion of light on the roadway and an economical maintenance of a lighting system, there can be no question of its desirability, for the following reasons: Prevents accident at dangerous curves and other obstacles; reduces headlight glare and consequently relieves eyestrain; facilitates making repairs; discourages holdups; encourages night motor freight traffic, thereby relieving daytime congestion; helps bring electricity to the farms by providing power lines.

The General Electric Co., through W. D'Arcy Ryan, will provide a system of lighting, developed after long experimentation, which, due to a highly efficient reflector, provides a uniform diffusion of light over the roadway surface, entirely eliminating the glare and effectively confining the illumination to the roadway proper. The lighting unit, a view of which is shown, will be mounted on concrete poles of simple design, 35 ft. high, and spaced 250 ft. centers, staggered. Lamps will be 2,500 lumens (250 cp.) Mazda C series, operated from a constant circuit, supplying 6.6 amp. received from a transformer on a primary line of 2,300 v., 60 cycles. Lighting current will be carried by a steel-armored cable buried about 12 in. in the ground.

Bearing in mind that the following lighting cost summary is based upon an installation for only about 2 miles of roadway, it will be admitted that the annual cost is not staggering, considering the benefits derived.

LIGHTING COST PER YEAR ON A TEN-YEAR BASIS

Assuming the system to be salvaged at the end of ten years for 25 per cent of the original cost, then the yearly cost with interest at 6%, payable in advance, will be 11.025 per cent of the original cost.

Investment on fixed charge	$1,721.00
Operation and maintenance	1,023.00
Total cost per year for system	$2,744.00
Cost per lamp per year, based on 44 fixtures	$62.50
Cost per year, per linear foot of roadway	$0.25

This installation is designed to illuminate a 40-ft. pavement. Cost of installation and operation for narrower widths would be somewhat lower.

10. Care of Pedestrians—Many pedestrians are killed and injured by motors, because no way is provided for them outside the pavement. Provision for human safety demands that wherever practicable footpaths or sidewalks be provided. A 5-ft. gravel foot-path 3 or 4 in. thick will be placed outside the roadway of the Ideal Section.

11. Warning Signs and Guard Rails—No differences of opinion exist as to the necessity for these safety factors. Adequate warning signs will be placed where necessary. Embankments over 3 ft. high will be protected by guard rail. The posts will be of concrete about 6½ ft. long and 6 x 6-in. square, having no top railing. Two side rails of 2 x 6-in. timber, properly spaced and painted white, will be fastened to the posts by U-bolts. These will enable ready replacement of broken wooden rails.

12. Grade Crossings—No railroad lines cross the proposed Ideal Section site at grade. The committee, in voting for the elimination of grade crossings, fully comprehended the economic problem involved, and realized that many years must elapse before attainment of this ideal is accomplished. It is on record, however, to the effect that ideal highway conditions preclude the existence of railroad grade crossings.

13. Underground Wires—Because in most instances pole and overhead wire lines along a highway detract from its sightliness, and in winter constitute an actual menace to users of the road, the technical committee voted to have all overhead wires placed underground. This action was taken in absence of knowledge of technical and practical telephone and telegraph operating requirements. Subsequent discussion of the matter with officials of the companies involved developed the fact that, especially for long-distance lines (those along the Ideal Section being transcontinental lines), the placing of wires underground is impracticable.

Submitting to conditions beyond its control and acknowledging the seriousness of interference with telephone and telegraph communications, the committee will make the best possible disposition of the pole lines. Full and cordial co-operation is assured by the companies involved.

15. Advertising Signs, Highway Markers—The indiscriminate placing of advertising signs within and along the public rights-of-way should be prohibited by law. Frequently placed across the inside of curves, or at road intersections, they constitute a positive menace to public safety. The committee unqualifiedly recommends their removal and future prohibition, by statutory enactment, in every state.

Owing to inconsistencies noticed where highway marking is done by many different agencies, the committee recommends that all distance and direction markers be placed only by proper state or local authority and that all distances should originate at the municipal headquarters of any town or community.

17. Maintenance—Maintenance of the roadway will be cared for by the State Highway Department of Indiana, since it is a part of a state highway route. Dis-annexation of the portions within the incorporated limits of the towns of Dyer and Schererville was effected by those towns to permit future maintenance by the state.

18. Comfort Stations, Camp Sites, etc.—It is the intention of the Lincoln Highway Association later to establish a comfort station and camp site for tourists. A generous acreage for this purpose has been promised by a citizen in the vicinity. Simple facilities will be provided to make the camp site comfortable for overnight stops.

Except in public parks little attention has, as yet, been paid to the systematic development of the natural beauty of our roadsides. Where there are underdrains whose functions might be disturbed by spreading roots, the close proximity of shrubs or trees is undesirable.

However, where no underdrains exist, the growth of natural bushes and shrubbery is an actual benefit in preventing erosion of slopes. Preservation of our roadside trees is a public duty, the evasion of which finds but little justification in the claim that they interfere with agricultural production, or the services of public utilities.

The Ideal Section is to be 1½ miles long. It will be built on the Lincoln Highway between the towns of Dyer and Schererville in Lake County, Indiana, about 12 miles south of Hammond, and 32 miles south of Chicago. Nationally central location, favorable topography and nearness to Chicago for inspection purposes determined the selection of the site.

Through the interest of C. B. Seger, chairman of the board and president of the United States Rubber Co., and J. Newton Gunn, vice-president, United States Rubber Co. and president, United States Tire Co., there was contributed toward the cost by the United States Rubber Co. $120,000. The State of Indiana, through its highway commission, with the approval of the Governor, contributed at the rate of $33,000 per mile, $49,500. Lake County, Indiana, will contribute $25,000. The total funds available, therefore, are $194,500.

Mr. Gunn is president of the Lincoln Highway Association and A. F. Bement, of Detroit, is vice-president, in active charge of its work.

The personnel of the technical committee appointed by the association to determine the general features of the specifications follows: W. D. Uhler, state highway engineer, Pennsylvania; A. R. Taylor, state highway commissioner, Ohio; H. E. Breed, consulting engineer, New York; Clifford Older, state highway engineer, Illinois; T. R. Agg, professor of engineering, University of Iowa; F. R. White, state highway engineer, Iowa; A. N. Johnson, dean, Engineering College, University of Maryland; Edward R. Hines, chairman, highway commission, Wayne County, Michigan; Col. Sidney D. Waldon, consulting automotive engineer, Detroit; L. H. Wright, former highway commissioner, Indiana; A. R. Hirst, state highway engineer, Wisconsin; Arthur H. Blanchard, professor of highway engineering, University of Michigan; Major J. M. Ritchie, Motor Transport Corps., U. S. Army; W. G. Thompson, former state highway engineer, New Jersey; Elmer C. Jensen, chairman, Lincoln Highway Committee, American Institute of Architects, Chicago, Illinois.

The writer is consulting highway engineer and Jens Jensen of Ravinia, Illinois, is consulting landscape architect.

Lockwood, Greene & Co., engineers, will handle the contracts through their Detroit office, in charge of T. C. Morris.

Traffic Increase in Iowa

In 1921 the total highway revenues, including motor vehicle fees, in Iowa amounted to $24,097,463, or 4.4 times those of 1910. During the same time, however, the number of motor vehicles registered increased from 10,422 to 481,535 or 46.2 times. In other words, the number of motor vehicles in the state, and consequently the traffic on the highways, has increased during the past 11 years, eleven times as rapidly as have the highway revenues. Thus, in 1910 the highway revenues from all sources amounted to $552 per motor vehicle as compared with $50 per motor vehicle in 1921.

Estimating Reproduction Cost of Buildings for Valuation

Establishment of Standard Types of Structures Allows Curve Cost to Be Plotted on Convenient Unit Basis

By F. E. Barnes
Supervising Building Valuation Engineer, New York Central Lines
(*Copyright, 1922, F. E. Barnes*)

THERE CAN BE found in any large railroad system buildings of almost every type—anything from a flag shanty to the highest-grade office building. In the case of a system such as the New York Central Lines owning approximately 35,000 buildings, it became necessary, in its valuation work, to prepare methods that not only would give accurate results, but eliminate duplication of work and reduce to a minimum the effort and expense in arriving at the proper values. To this end extensive studies were made as to the method to be employed in both field and office work.

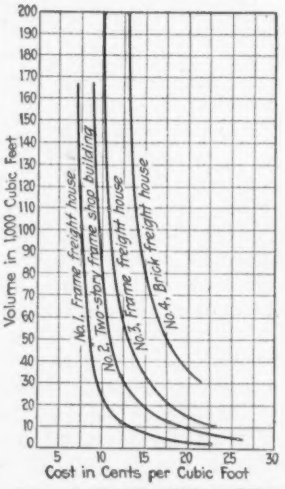

Volume in 1,000 Cubic Feet
No.1. Frame freight house
No.2. Two-story frame shop building
No.3. Frame freight house
No.4. Brick freight house
Cost in Cents per Cubic Foot

FIG. 1. UNIT COST, SHOP AND FREIGHT BUILDINGS

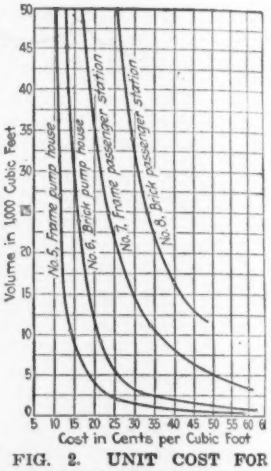

Volume in 1,000 Cubic Feet
No.5. Frame pump house
No.6. Brick pump house
No.7. Frame passenger station
No.8. Brick passenger station
Cost in Cents per Cubic Foot

FIG. 2. UNIT COST FOR SMALL STRUCTURES

Three Methods of Valuation—The Interstate Commerce Commission ruled that all roads be valued on a basis of prices existing in 1914. To determine the cost of reproducing new, structures already built and in use, there are three practical methods of procedure. In the case of a building recently constructed and the cost of which is known, the easiest and perhaps the best method is to revise the original cost by applying the cost difference between the year actually built and the year for which the valuation is required. The second method is to estimate a bill of quantities and apply the unit prices that would be used by a general contractor if he were bidding on a similar building. The third method consists in grouping a number of similar structures and estimating the cost of construction of a part of them to determine the correct cost of the others. For the third method usually spoken of as the type method, the prices can be applied either per square foot, cubic foot or any other suitable unit.

On the New York Central Lines it was more or less arbitrarily decided to use the first method where the buildings had been constructed since the year 1900 and where the original cost to date was known. This method was fully described in an article by the writer in *Engineering News-Record*, Oct. 7, 1920, p. 702.

The second method has been resorted to in cases in which the first or third method was found unsuitable.

Method Used in "Typing"—The third or type method has been used on the New York Central Lines for at least 80 per cent of the building structures. The typing was carried out as far as possible before the field work was done and the field survey was written up using the types. They were prepared not only for the buildings themselves, but for each portion of a building, such as roofing, flooring materials, wall surfacing (both exterior and interior), chimneys, etc.

If a building were of a decided type the field-survey man immediately placed it in that type and described only those portions differing from the type, but if a building did not easily fit into one of the types it was fully described. The work of description, however, was greatly shortened by use of the sub-types for the various parts of the building. A 3¼-in. x 5½-in. photograph was taken of each structure and these aided materially the work in the office. After the field work had been done the typing was completed in the office.

To do this a tabulation sheet was prepared giving the complete description of each type of building including its location, year built, length, width, height, kind of foundation, chimney, exterior and interior surfacing, roof, kind of framing, flooring and volume. All buildings placed in a given type by the field men were described on one of these sheets, the description of each building taking but a single line. The photographs, mounted on 5-in. x 8-in. cards were then placed before the type man and the field typing checked by use of the description and the photographs. Many buildings had to be changed from the type in which they had been placed to a more suitable one. Also, many that had been left out of types could be placed in one of the field types.

Plotting Type Curves—With this review of the types completed a certain number of buildings were selected from each type. These buildings, usually comprising the smallest, the largest and two or three intermediate ones, were then estimated, unit prices applied to them and the price per cubic foot figured. They were then plotted on cross-section paper, the vertical scale denoting volume and the horizontal the price per cubic foot. As the volume becomes small the price per cubic foot increases rapidly so that the resulting curve is always concave to the right and has the general appearance of an hyperbola, but is not a true conic section.

One fact brought out in plotting the curves was that for most types there is a size above which the price per cubic foot no longer decreases as the volume is increased. For shop buildings this frequently is as much as 200,000 or 300,000 cu.ft., but for the smaller roadway buildings it is often only 20,000 or 30,000 cu.ft. Such information should be helpful to those engaged in the design of buildings, for where the space required is double or more the volume that ceases to show added economy by increasing the size, it would be as economical to construct two buildings instead of one.

The eight curves on the charts shown herewith are for actual buildings and are fairly typical of all curves worked up by this method. The prices used in preparing these curves were those existing in January, 1922.

The lower portion of curves 4 and 5 and to a lesser degree 1 and 2 are too flat for accurate use in pricing small buildings falling under these types. For cases of this kind it has been our practice to redraw this portion of the curve increasing the vertical scale sufficiently to make the prices easily read.

In carrying out the cost quantities for type buildings, it is necessary to give the cubic feet and to show such additions and deductions as the individual building requires to bring it within the type. For instance, if the type has a shingle roof and the building in question has a slate roof, it is necessary to give the area of roofing priced at the difference between the two kinds. In making up the price per cubic foot, the superstructure should be kept separate from the substructure treating the two as separate structures. Frequently a superstructure will fit into a type while its substructure is entirely different from the other buildings of its class. It is often found that the substructure is special and has to be estimated, while the superstructure is easily thrown into a type. Such items as plumbing, heating, lighting, platforms, furniture, etc., should always be estimated separately.

In preparing the estimates both for the special buildings and those used for plotting the type curves, the work of estimating is greatly shortened by the typing of the various portions of the building previously referred to. For instance it is much quicker to take off areas by the square than it is to carry out such surfaces in feet, board measure of lumber, thousand of shingles, slate, etc. This method of saving time can easily be carried too far, detracting from accuracy and often causing work instead of saving it.

Sewerage Conditions in Small Cities

TYPICAL conditions and difficulties of sewerage systems in cities of the smaller class are illustrated by the following abstract from the annual report of H. H. Edwards, city engineer of Danville, Ill. (population, 33,776 in. 1920):

The past year has shown the need of new sewers and enlargement of some existing sewers. Flooded basements, inundated districts and other damage by storm waters have brought many claims for damages to the City Council. But it is difficult to see why the city at large should pay for them. In most cases, steps to install adequate sewers would have met with much opposition if taxed upon those property owners. It was demonstrated, however, that more funds must be made available for sewer maintenance and extension if a repetition of this flooding is to be avoided.

Many parts of our sanitary sewerage system are overloaded. The unlawful connection of downspouts from roofs has largely increased this overloading and must be stopped. Overflows have been cut into storm-water sewers to relieve the sanitary sewers, but this is a temporary relief and should not be allowed to continue, since the constant use of storm sewers for this purpose will be unsanitary and dangerous to the public health. Several new trunk lines and relief sewers are needed.

Recent rains have shown the need of better drainage on our streets and more storm sewers, as a number of these sewers were washed out by the excessive flow. The sewer on Collett St. has blown up the pavement almost yearly, and the expense thus caused warrants the laying of additional pipe to take care of the flow. Many other sewers were damaged, while numberless culverts and small drains were washed away. It is a waste of money to put in such sewers, for the investment is swept away at the first excessive rain. Storm sewers help keep our streets clean, for tons of dirt are thus carried away during storms. Stony Creek, which drains a large part of the city, is being made narrower and shallower by the continued dumping of refuse and rubbish along its banks. This can only cause more frequent flooding. Steps should be taken to stop all dumping and to clean out the channel.

Battling with the "Devil's Hole" in the Mississippi Flood

The Story of a Victorious Nineteen-Day Struggle to Save a Main Levee—Detailed Description of the Methods by Which a Crevasse Is Fought

By A. L. Dabney
Consulting Engineer, Memphis, Tenn.

IN THE lower Mississippi River, the flood of 1922 is now receding. For duration above bank-full stage, it broke all former records. For nearly 600 miles of the river's length, it broke all records for flood elevation. It is another and stronger vindication of the levee system. Between Cairo and New Orleans, there was only one break. There was much emergency work on the weaker sections of levee (not yet up to standard), and there were several weeks tense with apprehension.

Unique in the writer's experience was the development recently named the "Devil's Hole," in Tunica Co., Mississippi, in the Upper Yazoo Levee District. For nineteen days, large forces were engaged, day and night, in a successful effort to prevent the engulfing of a large section of the levee by this monstrous hole, which in one month enlarged more than it had in 19 years and developed into a veritable maelstrom. The accompanying maps almost tell the story. Around the bend of the river opposite the point of attack, the distance is about twelve miles. (See Fig. 1.) Across the wooded neck, it is a mile and a quarter. The slope across the neck is, therefore, ten times as steep as the river's slope. Water flows from the river through the intervening woods, to the cleared borrow-pit area along the levee. It rushes through this cleared strip at a high velocity.

FIG. 1. LAYOUT OF LEVEE
The point of land enclosed by the bend in the river is wooded except for a cleared borrow-pit area along the levee. The river swept across this neck rounding the point formed by the levee.

Origin and Growth — Before 1903 there had been some trouble in maintaining a bulkhead at the end of the spur which projected from the angle in the old levee (see Fig. 2). During the 1903 flood a hard fight was made to hold the bulkhead, which was lost during the latter part of that flood. The same year, a new levee was built behind this angle. Thereafter, no effort was made to hold the spur.

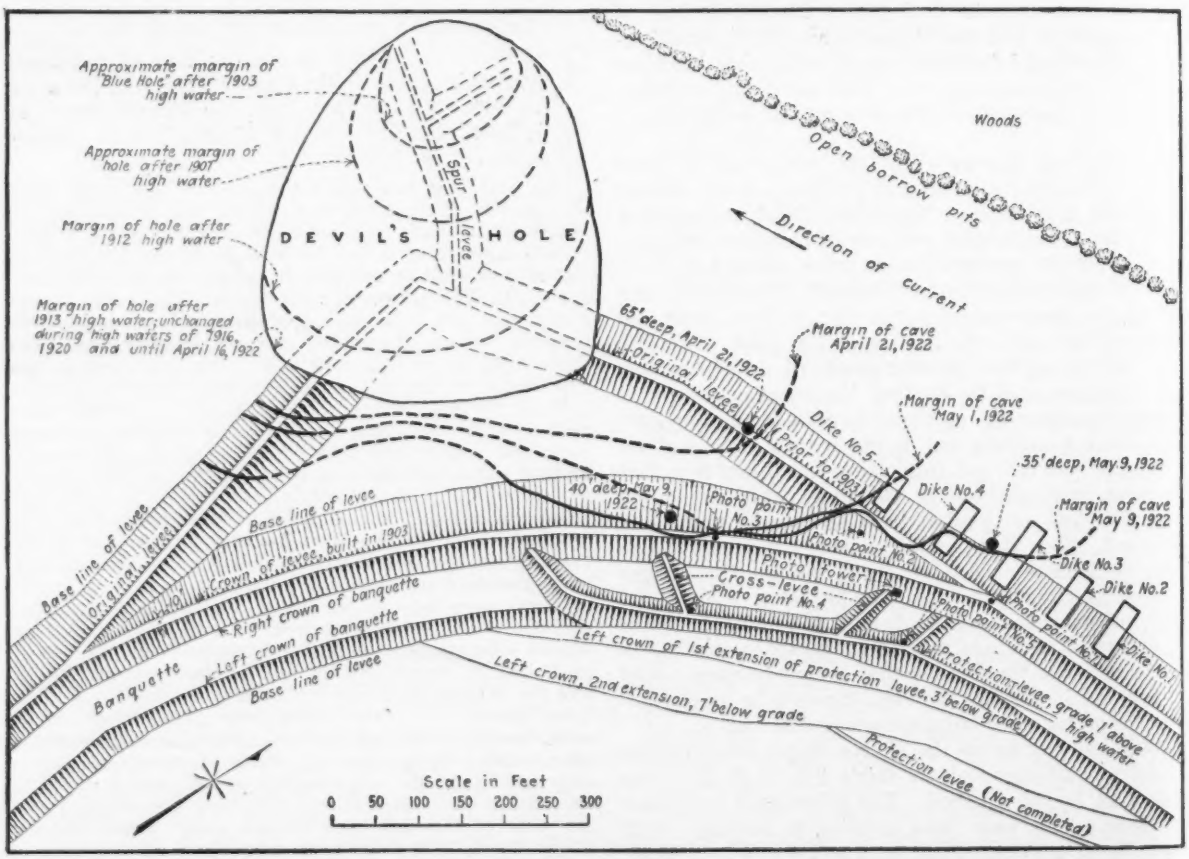

Approximate margin of "Blue Hole" after 1903 high water
Approximate margin of hole after 1907 high water
Margin of hole after 1912 high water
Margin of hole after 1913 high water; unchanged during high waters of 1916, 1920 and until April 16, 1922
DEVIL'S HOLE
Spur
Woods
Open borrow pits
Direction of current
65' deep, April 21, 1922
Original levee
Margin of cave April 21, 1922
Margin of cave May 1, 1922
Dike No. 5
(Prior to 1903)
35' deep, May 9, 1922
Dike No. 4
Margin of cave May 9, 1922
40' deep May 9, 1922
Photo point No. 3
Photo point No. 2
Dike No. 3
Dike No. 2
Base line of levee
Original levee
Old crown of levee built in 1903
Photo tower
Cross-levee
Photo point No. 4
Photo point No. 1
Dike No. 1
Right crown of banquette
Left crown of banquette
Banquette
Base line of levee
Left crown of 1st extension of protection levee, 3' below grade
Left crown, 2nd extension, 7' below grade
Protection levee, grade 1' above high water
Protection levee (Not completed)
Scale in Feet
0 50 100 150 200 250 300

FIG. 2. PLAN SHOWING PROGRESSIVE CAVING AND OPERATIONS TO SAVE LEVEE AT DEVIL'S HOLE
Here is shown the progressive enlargement of the "blue-hole" of 1903 and its invasion of the main levee section during the flood of 1922. The point from which the photographs in Figs. 5, 6, 7 and 8 were taken is marked "photo tower," and the several "photo-points" shown in this plan are indicated in the photographs by poles having white bands to denote the number of the point. The line marking the margin of cave on May 9 indicates the limit of the caving.

Whenever a levee crevasse occurs on the lower Mississippi, a deep hole is washed in the levee gap. Such holes are locally known as "blue holes." Usually they are about 50 ft. deep from the ground surface. Such a hole, of comparatively small area, was bored by the eddy action as the spur levee was washed away by the floods of 1903, 1907 and 1912; the last named flood cutting away the old main levee at the angle. A little more of the old levee was taken, by an enlargement of the hole, in 1913; and the "blue hole" had become a good fishing and swimming resort in low water time. It did not become the "Devil's Hole" until after April 16, 1922.

During the 1916 and 1920 floods, and for the first

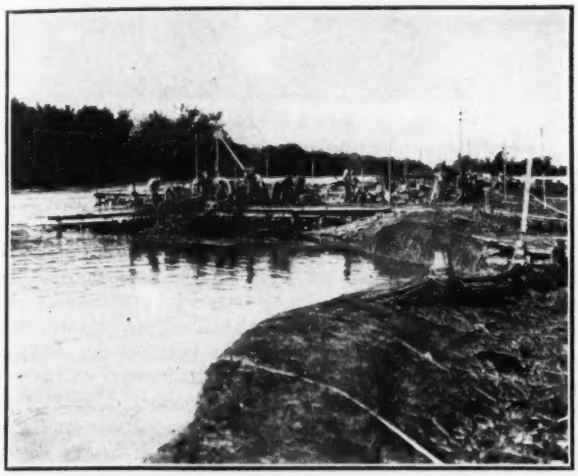


FIG. 3. DUMPING REVETMENT FROM DIKE NO. 4
This picture was taken May 6, looking upstream from a position very near to photo-point 2. The shore line shown is just about that marked May 9 on Fig. 2. Dike No. 4 was almost entirely undermined before the flood began to recede.

three weeks of the 1922 flood, no appreciable enlargement was noticed. On April 16 the old levee ends were observed to be in about the same positions as after the 1913 flood. On April 20 a levee guard noticed that the upper spur was rapidly going away. On April 21 the chief engineer of the district made a personal inspection and found that about 200 ft. had been lost in 5 days. He immediately set machinery in motion to organize for a hard fight. Twenty thousand empty sacks from storage were delivered the same day and a large force of plantation labor spent the night filling them. By the next morning half the levee board's organized team forces, distributed over 50 miles of levee were on the ground and at work building a secondary levee.

Early the morning of the 22nd, the writer, hastily called in, accompanied the chief engineer to the scene. Immediately, men were set to making large wooden mauls for driving hand-piling. Others were sent to the woods a mile distant to cut brush; and wagons were set to hauling it. Within two hours trucks were bringing lumber from four mills and lumber yards in the county. The same day, two special trains from Memphis (40 miles north) brought sacks and small piling timber, and trucks hauled these materials six miles from the nearest station. In the afternoon, a quarter boat borrowed from the U. S. Engineers at Memphis, was delivered at the levee near the work. This boat served dinner every day to from 200 to 400 laborers from the plantations. Later it quartered and fed 225 state convicts. One day it served dinners to nearly 800 men. The levee board's team forces were quartered in a hastily built tent camp.

Plan of Action—When we reached the scene, a very brief inspection was convincing that heroic measures must be adopted. It was immediately decided to first build permeable spur-dikes to divert the current farther from the levee and to be governed thereafter by developments; also, to build an emergency levee behind the main levee.

The team force had already begun a narrow fill on the landward edge of the banquette. Water was ponded behind by a permanent sub-levee, to depth of about 2 ft. at the base of the banquette. The sub-levee basin is 500 or 600 ft. wide and the field beyond was wet from seep water. Accordingly, material for the emergency levee was borrowed from the top of the main levee, for a length of about 1,500 ft. each way. Opposite the emergency levee, the top of the main levee was reserved for filling sacks.

About two hours after we arrived, a skiff had been brought from some miles away on a truck. With some difficulty a line was got across the 250 ft. of open water opposite the upper junction, and made fast to a tree. Holding the boat by this line, in an 8 to 10 ft. velocity,

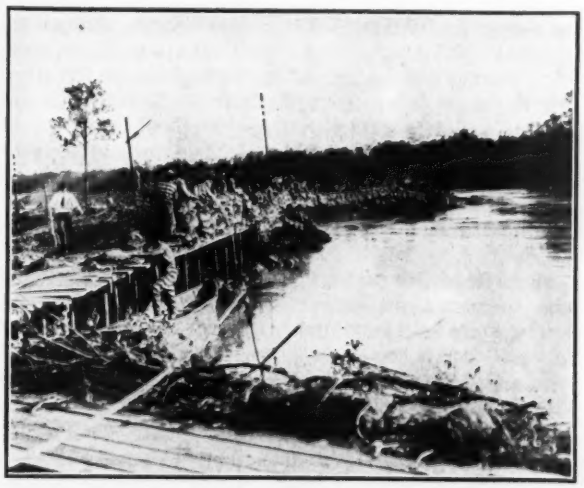


FIG. 4. PLACING "SNAKES" TO REVET MAIN LEVEE
This picture was taken May 6 looking down-stream from a point near photo-point 2. Photo-point 3 is indicated by the stake with the three white bands. The method of making and placing the "snakes" is described under the subhead "Fighting the First Cave."

soundings were taken that showed a maximum depth of 15 ft.

Inmmediately after this, Dike No. 2 (see Fig. 2) was begun. At first, 2 x 4-in. gum scantlings (doubled) were used for piling, driven about 4 ft. into the ground with heavy wooden mauls. Bents were spaced 4 ft. apart. The dikes were made 16 ft. wide, with 4 piles to the bent. In the afternoon, 300 4 x 4-in. sticks, 20 and 22 ft. long came from Memphis by special train, and with 24-ft. lengths received later, were thereafter used for piling. Caps and walings were 2 x 6 in. gum and pine.

By evening this dike had been extended about 30 ft. from the water's edge. The end was in such swift water that it was almost imposible to get in the last bent. As we advanced into deeper water, it had become

FIG. 5. BUILDING EMERGENCY PROTECTION LEVEES
This picture was taken from the photo tower (see Fig. 2), looking between photo-points 4 and 5. Figs. 5, 6, 7 and 8, all taken on May 7, form an almost continuous panorama extending from photo-point 5 around to dike No. 1. A cross-levee appears in the immediate foreground.

FIG. 6. CAVE IN MAIN LEVEE
Photo-point 3 is indicated by the tall stake in the center of the picture having three white bands near its upper end. At the left end of the cross-levee connecting the emergency and main levees is seen photo-point 4. Maximum penetration of the cave into the main levee was just beyond photo-point 3.

necessary to hold the bottoms of the piles, six men on the levee upstream holding them by the two ends of a line passed around the pile. It now became impossible to force the bottoms outward from shore against the diagonal pull of the line. This dike was temporarily discontinued and a start was made on Dike No. 1. During the night it was pushed out about 30 ft. Next day Dike No. 2 was extended to a length of about 50 ft. By stationing men at the end of No. 1 to hold the piles for No. 2, the pull on the line was more nearly directly against the current. With considerable difficulty, Dike No. 1 was later extended to a total length of about 45 ft.

A Critical Moment—The evening that Dike No. 2 was completed, an accident occurred which caused the writer more serious apprehension than was experienced at any other time. Due to ignorance on the part of a workman, an attempt was made to draw a skiff upstream from the end of this dike, pulling by a line from Dike No. 1. The current whipped the boat round against the upstream side of No. 2 and capsized it, open side upstream. Even after the boat was torn partially in pieces with pike poles, no force that we could apply would move it. For fear that it would cause an underscour and start a new "Devil's Hole" very near the base of the levee, three bents of the dike were sacrificed by cutting the walings and pulling the piles, in order to free it from the wrecked boat. It took half the night to accomplish this.

When the dikes were begun, it was planned to drive later a line of piling at about 1-ft. spacing, revet the bottom within the dikes with sacks and partly fill the dikes with brush. It was found that the open pile bents created so much head that it would be hazardous to increase the obstruction. There would be great danger of creating a scour at the ends of the dikes. An attempt was made to partially revet the bottoms by forcing down bundles of cane and poles with several sacks tied on for weight, having each bundle bear against two piles. Most of these were swept through, as was suspected at the time, and later confirmed after the water fell. Although the total head created by three of the dikes was 0.8 ft., there was no erosion under them as long as they were subjected only to the action of the direct down-stream current. The levee and the ground are both a very stiff "buckshot" material.

Dikes Nos. 1 and 2 so retarded the current near the levee below them, that Dikes Nos. 5, 4 and 3 were built (in order named) with much less difficulty, except the outer bents of Nos. 4 and 3 for which it was necessary to hold the piles by a line from the dike above. No. 5 was built with a hand pile driver (piles 8 ft. in the

FIG. 9. DIKE NO. 2 AFTER FLOOD SUBSIDED
Here is shown the upper end of the caving into the slope of the levee and the extent to which the dike was undermined.

FIG. 7. REMNANT OF OLD LEVEE

To the left is seen photo-point 2, indicated by the stake with the two white bands. The men are standing on a remnant of the crown of the old levee. Dike No. 5 was at this point before it was swept away. Note the eddies and boils in the river.

FIG. 8. DIKES NO. 1, 2, AND 3

Dike No. 3 is in the foreground. Photo-point 1 is on the extreme right, indicated by the stake with one white band. These dikes were built at the beginning of the struggle to help divert the current from the threatened face of the main levee.

ground). Later, this driver was used to double up on the hand driven piles in the other dikes, driving spliced piles 10 to 14 ft. deep.

Fighting the First Cave—The dikes so retarded the advance of the gorge that for a week after they were begun, its enlargement was very slow. On May 1 there appeared the first cave above water in the main levee. Work was immediately begun rolling "snakes" of sacks and brush into the cave. Each earth-filled sack was belted with a ¼-in. line. A row four sacks high was laid, sides touching, along the brink of the cave, each sack tied to the one under it. A ¾-in. line was then laid along the top, and the small line from each top sack tied to it; then brush was applied liberally and tied to the large line, the end of which was anchored to posts and "deadmen," allowing 30 to 40 ft. slack for the snake to sink. The mass was then rolled into the water. This operation was repeated until four to six snakes had been made, then a number of detached bundles of brush with eight to twelve sacks tied to each were rolled in to take lodgment on the snakes. More "snakes" were then applied, followed by more bundles. After 24 hours of constant work, the top of the mass appeared at the water surface. The next 24 hours were spent applying snakes and brush so as to extend both ways, the revetment formed in the cave.

The Second Cave—Two days after the first cave in the levee, a large cave occurred in the old spur, immediately behind Dike No. 5 which, during the preceding two days, had been undermined by the eddy working up to its lower side. The gorge had advanced upstream on a line further out than its original course. For *four days and nights*, sack "snakes" and brush bundles were poured into this last cave, before the top of the revetment appeared above water. It remained so for three hours, then subsided about 15 ft. and the application was resumed for some additional hours before the top of the revetment could be held at the water surface.

The next "thrill" occurring about this time, was a 20-ft. subsidence of the revetment in the cave of May 1, and immediately thereafter, the sliding in of another section of the main levee, to the line dated May 9. A call was sent out for more labor, and during that day about 650 men filled, carried and applied sacks; while 20 wagons hauled brush from the woods. This cave was revetted in 24 hours. For the next few days we were occupied applying liberal revetment to check the advance of the eddy toward Dike No. 4. Later on, as the river fell, Dike No. 4 was almost entirely undermined by the advances of the eddy, while the main gorge took the ends of Dikes No. 3 and No. 2.

FIG. 10. CAVE IN MAIN LEVEE AFTER FLOOD SUBSIDED

Taken at photo-point 3, this picture shows how the padding of brush and sacks covered the raw places and helped to check the cave.

Work Behind the Levee—For the first few days of operation, the team force was engaged in "edging out" with a base lift, extending from the banquette slope over the mud and water after the sub-levee had been cut to drain the ground. This work was done by "side dumping" and rolling the large clods forward by hand. As this base was sufficiently widened for space to work them, additional teams were brought. The maximum team force was 70 wheel scrapers, with "snap" and plow teams.

After May 10, the fall in the flood water was so rapid that work was discontinued.

Summary of Result—The cross-section (Fig. 11) shows the nearest approach of the flood water to the temporary levee. Had the caving advanced 60 ft. farther and then stopped, this temporary levee would have been worth to the district, on a hasty estimate, about ten million dollars. It was determined at the beginning to hold the main levee at any cost. If this could be done, we would not have a break. If not, the result would be very doubtful. If the maximum stage of this flood had been sustained for several weeks longer, even more heroic measures would have been necessary, and the outcome would have been questionable.

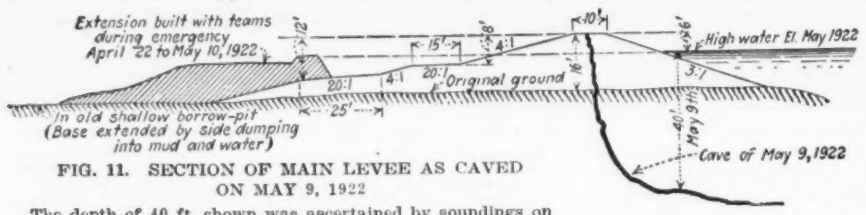


FIG. 11. SECTION OF MAIN LEVEE AS CAVED ON MAY 9, 1922

The depth of 40 ft. shown was ascertained by soundings on May 9. On the rear slope of the main levee is shown the emergency levee which was not brought into service.

In ten days we poured into "Devil's Hole" at least 100,000 sacks, between 500 and 800 wagon loads of brush, about 50 coils of ¾-in. and 250 coils of ½-in. rope. The cost of the work, not computed as yet, will probably exceed $50,000. The investment paid, at a conservative estimate, ten thousand per cent.

Before the next flood season, a new levee will doubtless be built a very safe distance back, and substantial pile dikes will be built to retard the current and stop the enlargement of the gorge.

W. L. Head, chief engineer, was in general charge of high water work in the Upper Yazoo district, while Major T. G. Dabney, consulting engineer, acted in an advisory capacity. The writer was in direct charge of the work at "Devil's Hole."

Forestry by Scranton Gas & Water Co.

A total of 985,000 trees, of which 505,000 are white pine, have been set out by the Scranton Gas & Water Co., of Scranton, Pa., in its work of reforesting its water-gathering ground. This fact was brought out by George R. Taylor, of the company named, in a paper read before the recent convention of the American Water Works Association. In conjunction with the Pennsylvania State Forestry Department, the water company has erected a steel fire tower in which the state maintains an observer. In addition, the company has a wood tower of its own. During the current year the Pennsylvania Forestry Department will send out 1,000,000 trees for planting. It expects to supply some 3,000,000 next year and 20,000,000 a year by 1925.

Court Denies Infringement of Warren Paving Patent

Fresno County, Cal., Is Victor in First Suit Involving the Wallace Claims—Appeal Likely

CLAIMS of infringement of the Wallace patent (No. 959,976) for bituminous pavement, with respect to both process and product, were denied Warren Bros. Co., of Boston, in a decision which Judge Benjamin F. Bledsoe, of the U. S. District Court, rendered May 29 at Los Angeles, Cal., in the case against Thompson Bros., contractors, and others, involving road construction in Fresno County, Cal., under specifications prepared by Chris P. Jensen, county surveyor. In the Fresno County work the lower course of the pavement was rolled prior to the application of the top course, while the Wallace patent provides specifically for the "bonding and blending" of the two courses with only a single rolling. (See article "The Status of the Warren Company's Pavement Patents," in *Engineering News-Record*, Dec. 15, 1921, p. 969). Supplementing the announcement of Fresno County's victory in last week's news section (p. 970) the full text of the Court's memorandum opinion is given below:

THE COURT'S OPINION

"In this case I have given very careful study to the numerous and rather lengthy briefs filed by respective counsel herein. So, also, I have endeavored to familiarize myself with the prior art involved in the paving business. The patent sued upon, No. 959,976, in view of the prior art and particularly in view of the prior art as exhibited by patent No. 727,505 granted May 5, 1903, is to be rather narrowly construed. In other words, within the limitations then existing there was not much left for the patentee to patent and this is peculiarly opposite in view of the specifications in patent No. 727,505 to the effect that the pavement therein provided for 'may be covered, if desired, with relatively thin surfacing of clear asphalt-cement or an asphalt or bituminous composition of any desired nature. In some instances there may be rolled into this thin surfacing while it is yet soft sufficient sand, gravel, or fine stone to prevent its displacement by traffic.'

"The first claim of plaintiff's patent being for a process, in the light of the specifications and in the light of the claim itself, must be read as a claim for a pavement consisting of an upper layer laid upon a lower layer without any intermediate compression of the lower layer. Obviously, this claim was not infringed by defendants' structure unless it may be said by the court that the laying of the upper layer of defendants' pavement after the preliminary rolling with the 12-ton roller, was merely the substantial equivalent of the laying of the pavement without any preliminary rolling of the first course at all. This, the court, from an inspection of the pavement laid no less than from a consideration of the process actually followed, cannot find to be the fact.

"The second claim of the plaintiff's patent is for a product. Read in the light of the specifications it is for a product laid in pursuance of the process indicated in the patent. I understand the law to be, however, that a product having definite characteristics by which it may be identified and which distinguish it from the process by which it was produced may be properly described by such characteristics, and when so claimed and described, the

claim will not be limited to the process specified. (Walker on Patents, Sec. 106.) Construed in the light of this principle, I am persuaded that the second claim is not to be limited by the precise process specified in the patent. It does, however, specify a product or pavement composed of two courses, the upper course disposed on the lower course and made up of finely divided mineral matter mixed with sufficient bituminous binding material to thoroughly coat all of the particles 'and blended with the coarse mixture at the top of the mass.' Construed in the light of the specifications, as the court should construe any claim of a patent, (Walker on Patents, Sec. 182) the requirement that the upper course shall be 'blended' with the lower course is to be read in the light of the specification that the two courses were to be laid one upon the other without any intermediate rolling. In truth and in fact, in this wise only could there be a composite, blended course.

"I am persuaded from a consideration of all of the facts involved, including an inspection of the pavement produced by the defendants, that the two courses of the pavement produced by them were and are not blended within the meaning of that term as used in plaintiff's patent. In my judgment, therefore, there is no infringement of plaintiff's patent shown by the product of defendants. The specifications employed by the defendants do not infringe the first claim of the patent for the reasons heretofore suggested.

"The real contention of plaintiff seems to be that its patent is infringed if an upper course of a pavement be laid upon a lower course of the same while the lower course is yet in a hot or plastic condition, irrespective of whether it is rolled intermediately or not. In view of the prior art I cannot conclude that plaintiff is entitled to have its patent thus construed, because the patent No. 727,505 issued to Warren in 1903 and which expired before defendants' structure was produced, as hereinbefore referred to, indicated the laying of a 'bituminous composition of any desired nature' upon an undercourse and the rolling into this 'while it is yet soft' of sand, gravel or fine stone. This contribution to the art, in my judgment, negatives now the broad claim which plaintiff seeks to have injected into his patent.

"The usual decree of dismissal will be entered."

Mr. Jensen's Comment

Engineering News-Record has received the following comment on the case from County Surveyor Jensen:

"This case is based upon as what is known as the Wallace patent, (No. 959,976). This contemplates the laying of an asphaltic concrete made up with a coarse aggregate and spreading the same to as uniform a surface as possible, without rolling; then the patent contemplates that a small amount of sheet asphalt mixture be spread over the coarse mixture; and then that the whole structure be given the only rolling to which it is subjected.

"In our observation of the product produced by this process we noticed that some considerable quantity of the coarse mixture from the lower layer was disturbed to such an extent as to protrude through the upper layer of sheet asphalt mixture. This, in effect, rendered the wearing surface pervious to moisture. In our observation and study of this pavement, we conceived the theory that a more impervious wearing surface would be produced if the coarse mixture was rolled prior to the application of the sheet-asphalt seal coat. We therefore revised our specification as to include this intermediate rolling. We also changed the mixing formula slightly from that of the Warren specifications.

"Our specification then, really, is nothing but the ordinary sheet asphalt pavement of prior use, except that instead of having a 2-in. or a 1½-in. sheet-asphalt wearing surface, we employ a surface only ¾ in. thick. The Judge has grasped the idea, as indicated by his reference to the old Warren patent, (No. 727,505) in which it is stated that a relatively thin surface of asphaltic mixture may be placed over the pavement.

"Fresno County has laid some 60 miles of pavement under our revised specifications and we contemplate the construction of 50 or 60 miles more. It is hard to predict what further effect the decision will have on local work. I anticipate that, under bond-issue work, advantage will be taken of this decision immediately, but under assessment district proceeding, I rather fear no change will be noticed until the decision has been affirmed by the Circuit Court of Appeals at San Francisco. The decree of dismissal will be written about the first of July. In view of the issue at stake we are expecting that the Warren company will appeal."

American Engineering Council Adopts Report on Registration

AT the meeting of the Executive Board of the American Engineering Council of the Federated American Engineering Societies held in Pittsburgh on May 27, the following report by the committee on Registration of Engineers was adopted:

In considering matters of government as affecting the engineering profession of the United States, the ancient principle which states "that country is governed best which is governed least," has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

Engineering in the United States under absolutely untrammeled conditions in the past, has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control. Within the past few years, however, a widely supported movement had appeared, resulting in the passage of laws, requiring licensing or registration of engineers in various states, and attempts at similar legislation in others.

It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

The registration or licensing of engineers with consequent elimination from practice of all not registered, can be supported upon two grounds: (a) the benefit of the profession; (b) the good of the public. Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

Your committee, while recognizing that required registration might not have been recommended ab initio believe that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.).

(a) Your committee recommends to the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works.

(b) Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers.

(c) Your committee is unable to agree as to the wisdom or unwisdom of registration of engineers engaged in other classes of work.

(d) Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

(e) Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

Field Check on Formulas for Earth Pressure

Thrust of Saturated Bank Measured by Deflections of Cofferdam Wales—Extent to Which Drainage Reduces Pressure

By H. S. Schick
Supt. U. S. Engineer Department, Wheeling, W. Va.

THE pressure on vertical steel sheetpiling under a 24 ft. dept of submerged bank was measured by observing the deflection of wale timbers in a cofferdam 41 ft. 7 in. wide x 180 ft. long during the construction of Ohio River Dam No. 23. The purpose of these measurements was to obtain information as to the intensity and distribution of the pressure exerted by a saturated bank against a vertical wall and especially to learn what reduction in pressure would result from drainage under the sheetpiles. Many investigations have been made of the pressure exerted by granular materials, and the design of retaining walls is usually based on such analyses, but very little information is available as to the pressure actually exerted by saturated material, although a wet bank is generally recognized as the final test of most retaining walls. Weep holes, or some form of subdrainage, are provided to relieve hydrostatic pressure but we have no means of knowing how effective they are.

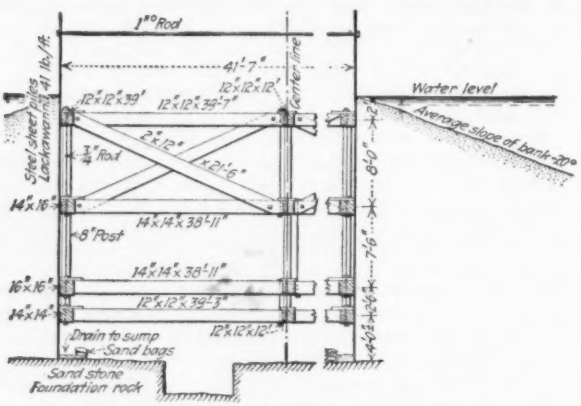


FIG. 1. CROSS SECTION OF COFFERDAM
This section, taken together with Fig. 2, shows type of cofferdam framing.

The measurements at Dam No. 23 included field tests of two full sized wales, 12 x 12 in. and 14 x 14 in. to determine the modulus of elasticity of the timber used; the deflection of nearly all the wale timbers in the cofferdam was measured as soon as the cofferdam was unwatered; soundings were taken around the cofferdam to determine the slope of the submerged bank and samples of the material were measured and weighed both wet and dry.

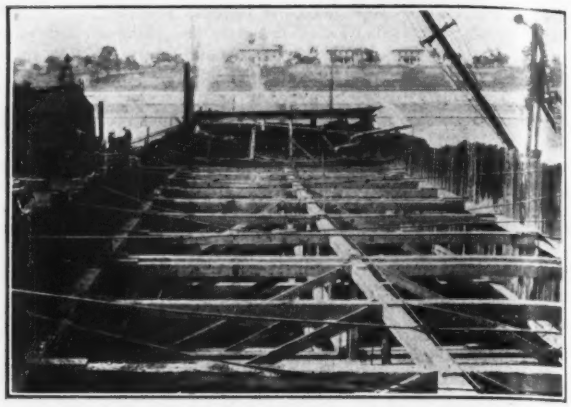


FIG. 2. VIEW LENGTHWISE OF COFFERDAM
Details of cross-bents are shown in Fig. 1. These were 13 ft. apart and the wales were continuous over four supports. The double transverse struts mark the ends of each wale timber.

The modulus of elasticity was determined in the material yard by measuring the center deflection of the timbers with approximately 30 ft. spans under known concentrated center loads varying from 380 to 2,280 lb. The deflections were measured by a simple device which showed readily variations of 0.001 in. The loads used were structural units all of which had been weighed. They were carefully placed one over the other near the center of the beam; readings were then taken just after each increment was applied until the total of 2,280 lb. was reached; this was allowed to rest about two hours and readings were then taken as each load was removed. The results of this test are shown in Table I. The values are considerably higher than those usually given in standard handbooks, but as standard tables give little information as to the probable limits of the values recorded and as the results of the test seemed reasonably consistent, a value of 2,000,000 lb. per square inch was used in the subsequent analysis.

The wales in the cofferdam were continuous over four supports and the alignment of the wales on their supports was good, but to have measured the deflection over the intermediate supports and to have measured that of the middle span would have greatly increased the labor required without any appreciable compensation in increased accuracy. The measurements, therefore, were confined to the end spans, between the end supports and the nearest points of contraflexure. The distance between supports was uniformly 13 ft. so the point of contraflexure was assumed to be uniformly 10.4 ft. from the end support and the deflection was measured 5.2 ft. from that support. Measurements were made with a gage by offsets from a fine thread nearly parallel to the wales. The observed deflections are shown in Table II together with the corresponding loads *W*, which, distributed over the 13 ft. span, would produce the observed deflection. The deflection at the points marked "?" were not measured because of obstructions in the cofferdam. As would be anticipated the measurements show considerable variation, but the differences can readily be accounted for by imperfect alignment of the wales, imperfect alignment of the sheet piles, varying pene-

TABLE I—MODULUS OF ELASTICITY OF BOGALUSA PINE COFFERDAM WALES.

	12 in. x 12 in. 31.33 ft. free span; Symmetrical, Concentrated Loads, 2 ft. 2 in. From Center of Span			14 in. x 14 in. 29.25 ft. free span; Symmetrical, Concentrated Loads, 2 ft. 6½ in. From Center of Span		
Test No.	Wt. Lb.	Defl. In.	E	Test No.	Wt. Lb.	Defl. In.	E
1	380	0.106	2,230,000	1	380	0.0376	2,720,000
2	760	0.205	2,280,000	2	760	0.108	1,890,000
3	1,140	0.306	2,320,000	3	1,140	0.169	1,820,000
4	1,520	0.403	2,350,000	4	1,520	0.225	1,820,000
5	1,900	0.513	2,310,000	5	1,920	0.291	1,760,000
6	2,280	0.669	2,120,000	6	2,280	0.357	1,720,000
7	1,900	0.531	2,230,000	7	2,280	0.357	1,720,000
8	1,520	0.436	2,170,000	8	1,900	0.296	1,730,000
9	1,140	0.334	2,130,000	9	1,520	0.240	1,709,000
10	760	0.213	2,230,000	10	1,140	0.183	1,680,000
11	380	0.106	2,240,000	11	760	0.122	1,680,000
				12	380	0.056	1,830,000
Average for 12 in. x 12 in			2,237,000	Average for 14 in. x 14 in.			1,839,000

tration and support in the rock foundation, and varying moduli of the elasticity of the timber.

Faulty alignment of the wales will account for much variation but errors arising therefrom will be compensating, so the average of a large number of observations should give a true value. Errors due to the alignment of the sheetpiles are of two kinds. Those due to poor horizontal alignment are compensating, for excessive deflections due to concentration of pressure at the center are offset by concentrations at or near the supports. This is not true, however, of errors in vertical alignment, because in order to facilitate lowering the wales before the pumps were set, the sheetpiles were driven, insofar as possible, so that they would stand

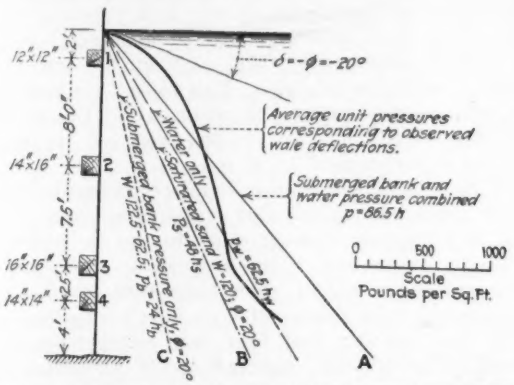


FIG. 3. OBSERVED AND THEORETICAL PRESSURES

The higher pressures at the level of the topmost wale are due in some measure to the piles having been driven with a slight batter so that they stood away from the lower wales before load was applied.

slightly off of the lower wale, thereby giving the piles a slight batter toward the inside of the cofferdam before driving. The result of this was a concentration of pressure on the top wale. In the table and in Fig. 3 this concentration is obvious. There is some tendency also to error caused by variation in the bearing on the rock. Wherever the piles stood off from the wales, the rock took an excessive share of the load, but where the piles did not penetrate the rock at all, it could take no horizontal reaction and the wale took an excessive share. To what extent errors result from variations in the moduli of elasticity it is impossible to tell definitely; the pieces selected were in every way representative of those in the cofferdam; they were of the same lot and had actually been used in another section so that they had been thoroughly water soaked as well, but because of the variability of the modulus of elasticity of timber there is some question whether the timber in the cofferdam was of the same elasticity as that measured on the bank. The results of the test, however, seem to show that there was little net error due to this cause, for if the saturation of the timber was sufficient to cause appreciable variation in the modulus of elasticity, those timbers which showed the most thorough saturation, those in the lowest two courses, Nos. 3 and 4, would have shown the largest proportional deflection. But the contrary is true. The upper timber was fairly dry when the measurements were made; yet it showed higher deflections than the lower timbers, which were always soaked. The fact that the total of the observed loads on the four wales is so nearly equal to the pressures determined by a reasonable application of the theory of earth pressure indicates little net error due to variation in elasticity.

In Fig. 3 is shown a comparison between the loads as measured by the deflections and the pressures determined by theoretical analysis. The pressure lines are so drawn that horizontal ordinates at any point show the pressure per square foot at that point to the indicated scale. The line *B* shows pressures derived from the general equation for earth pressures taking ϕ at 20 deg. and *W* at 120 lb. per cubic foot. This line is shown because many retaining walls subject to saturation of backfill have been designed on that basis. The line *C* shows pressures computed on the same basis except that *W* is the actual weight of the saturated material diminished by the weight of a cubic foot of water. That is, 122.5 — 62.5, or 60 lb. per cubic foot was taken as the submerged weight of the material. The line *A* shows the combined hydrostatic pressure and submerged bank pressure as shown by *C*. The corresponding equation, $p = 86.5h$, therefore, represents the horizontal component of the total saturated bank pressure with the water level at the top of the bank.

The reduction in pressure due to the drainage under the sheetpiles was about 16 per cent of the total theoretical pressure. The total observed pressure on the four wales in one panel was 235,080 lb., while the total theoretical pressure corresponding to this was 279,480 lb. leaving 44,400 lb. reduction to be accounted for by drainage under the piles. This drainage was considerable, requiring under the given conditions the service of two 10-in. centrifugal pumps to keep the cofferdam dry. A reduction of 16 per cent, therefore, is as much as can be hoped for with such drainage. This, of course, takes no account of the differences in the reaction of the rock. If it were assumed that the rock actually carried no horizontal load whatever it could be made to appear that the reduction amounted to 2.5 per cent, but although there was no opportunity to measure the reaction of the rock directly, it is known that this was considerable for at one place it was sufficient to shear off a 3-in. layer of rock between sheetpile and key.

The above observations seem to justify the conclusion that steel sheetpile cofferdams offer favorable opportunities to study the intensity of earth pressures. The values here derived may be applied directly only to similar cases of continued complete saturation but the relatively small reduction in pressure due to drainage is of especial significance.

TABLE II—DEFLECTION OF COFFERDAM WALES

Wales were 39 ft. long and were continuous over 4 supports with 3 spans of 13 ft. Deflections of external spans, between the outer supports and the nearest point of contraflexure, only were measured. These parts were equivalent to simple spans 10.4 ft. long. *D*-deflection in inches, 5.2 ft. from support. *W*-corresponding load in pounds on full span of 13 ft.

Wales Panels	No. 1, 12x12 D	W	No. 2, 14x16 D	W	No. 3, 16x16 D	W	No. 4, 14x14 D	W
B	0.175	29,800	0.135	63,600	0.17	92,000	0.265	83,400
D	0.120	20,400	0.48	226,000	0.14	75,700	0.14	44,100
E	0.23	39,100	0.00	0	0.135	73,100	0.175	53,500
G	0.19	32,300	0.08	37,700	0.00	0	0.115	34,600
H	0.055	9,350	0.14	66,000	0.00	0	0.25	78,700
K	0.28	47,700	0.19	89,500	0.21	113,800	0.355	111,900
L	0.16	27,200	0.17	80,000	0.29	157,100	?	?
M	0.14	23,800	0.09	42,400	0.03	16,230	0.00	0
B'	?	?	?	?	0.03	16,230	0.22	69,300
D'	0.29	49,300	0.185	84,800	0.035	18,950	0.14	44,100
E'	0.20	34,000	0.21	99,000	0.25	135,200	0.23	72,400
G'	0.22	37,400	?	?	0.17	92,100	0.08	25,200
H'	0.15	25,500	0.23	108,000	0.28	151,500	0.22	69,300
K'	0.125	21,200	0.21	98,900	?	?	0.00	0
L'	0.155	26,400	0.16	75,400	0.145	78,500	0.075	23,620
M'	0.24	40,800	0.36	170,000	0.00	0	0.005	1,600
Av. values		30,950		88,660		68,020		47,450
Theoretical Values	*A*	13,980		96,500		104,000		65,000
	B	7,750		53,500		58,000		36,000

The theoretical values *A* and *B* were computed by using the respective formulas *A* and *B* given under Fig. 2.

Solving the Problems of the Portland Cement Industry

What the Portland Cement Association Is Doing To Improve Cement and Its Ultimate Product, Concrete

By F. W. Kelley
Chairman, Committee on Technical Problems, Portland Cement Association

Some editorial remarks in "Engineering News-Record," notably in the article "Concrete—Past and Future" in the issue of Jan. 5, 1922, have been construed as giving the impression that the cement manufacturers are not carrying on sufficient research work to insure an increasingly better quality of cement and concrete. In defense of the manufacturers, Mr. Kelley has prepared the following statement of the philosophy and purpose underlying the work of the Portland Cement Association, in which is centralized the research and promotion activities of the industry.—Editor.

It is now almost one hundred years since portland cement was invented. It is now manufactured in almost every country in the world. It is made from a great variety of materials, all of which, however, contain the essential ingredients of lime, silica, and alumina, combined invariably with other ingredients, such as magnesia and iron, and smaller quantities of rarer elements.

The methods, processes, and machinery for handling these diverse raw materials and converting them into a product which can be relied upon to give substantially similar results when used in concrete, are as diverse as are the materials. No two cement manufacturing plants are alike, although as the result of experience and through the establishment of standards, it has been found possible to reach by an almost infinite variety of means, a substantially uniform end.

Specifications—In every country, largely as a result of practical experience, there have grown up specifications which in general place a maximum limit upon the quantities of non-essential materials which may be present, and prescribe certain minimum physical requirements for the product, in order that it may be deemed satisfactory as an article of commerce, and be relied upon to give results consistent with those of past experience.

The specifications for cement in the United States are now a uniform standard, known as Specification No. 1 American Engineering Standards Committee, adopted by the United States government departments, by substantially all of the engineering societies, and are guaranteed by cement manufacturers.

The manufacture of portland cement calls for very large capital investment; the capital turnover is less than once yearly; and the power consumption per unit of output is enormous when compared with other industries. By reason of its heavy shipping weight, it is peculiarly essential that its manufacture be conducted as close as possible to the point of use, and it is only because its manufacture has been successfully accomplished throughout all parts of this country, that this convenient building material has been made everywhere available to the user at a per pound price which has been less than that of most manufactured materials of commerce, and comparable with partially treated natural products, like common salt.

Object of the Association—Portland cement when completely manufactured and ready for the consumer is, in its relation of usefulness to the community, a means and not an end. Its useful end is that of an essential ingredient in making concrete. Concrete is a mixture of cement and water, generally combined with aggregates. Concrete may be made by anyone possessing cement, water and aggregates. Good concrete may be obtained only by properly selecting these materials, proportioning them rightly, mixing them by suitable methods and for the right length of time, placing them in suitable forms and under appropriate conditions, and protecting and curing them adequately and properly.

The very ease with which the materials may be handled leads to their use. Any one of the active adult population of the United States is a possible user of cement, and the problem facing the manufacturer of the product is not so much that of urging people to use cement, as to use it right. This object has been basic in the organization and development of the Portland Cement Association, and in the work of its several service departments.

A few years' experience in this co-operative service work indicated that so-called practical experience in the use of cement in making concrete was an insufficient basis for development. In almost every case, materials and conditions varied, even laboratory investigations had been generally conducted in such a way that more than one variable had been left uncontrolled. The results of laboratory tests made in different places were frequently inconsistent, and sometimes misleading. The need for further study and a sound determination of fundamentals grew constantly more apparent. Only a determination of the effect of a variation in each of the essential materials and conditions involved in the making of concrete, could give us sound knowledge.

Research Laboratory—With this idea in mind, after a number of years' study and consideration of the matter, in December, 1914, a comprehensive report was presented to the Portland Cement Association covering scope and details of a research laboratory, based upon such information as could be obtained from laboratories undertaking somewhat similar work. This report resulted early in 1916 in the arrangement between the Lewis Institute in Chicago and the Portland Cement Association, under which they jointly established and agreed to operate the Structural Materials Research Laboratory under Prof. D. A. Abrams. Much important research work in concrete had already been done in the laboratory, and this was continued and enlarged in scope; the physical equipment increased and improved and the operating staff enlarged.

The appropriations of the association for research work which were $3,150 in 1914 increased to $20,000 in 1916 and to $81,000 in 1921, there being a gradual development, enlargement, and improvement in the work. These are laboratory expenses only, and are in addition to the much larger sums required for co-ordination with field work and for providing the necessary service to the public.

The report of the laboratory in 1919 showed that important information had been gained on—(1) How to make concrete tests; (2) Effect of size and grading of aggregates; (3) Effect of quantity of water; (4) Effect of quantity of cement; (5) Effect of fineness of cement; (6) Effect on wear of materials, proportion and manipulation; (7) Effect of organic impurities; (8)

Effect of powdered admixtures, and (9) Effect of time of mixing.

The effect of the work of this laboratory on the knowledge and practice of making concrete is now pretty well recognized by engineers. No claims for originality are made for this work, except that the conditions under which it has been carried on have permitted a character of control, a completeness, a comprehensiveness, and a relatedness of tests which have given definite indications and established definite relations which heretofore have been open to question. It has had a profound effect not only in increasing the quality of concrete, but in decreasing its cost.

Economic Bearing—From time to time questions have arisen as to certain inherent features of a given cement which affect its quality. For instance, there was a time when increased fineness of grinding of cement was advocated as a means of improvement. Most careful researches were made into this phase of the subject, and it was established that an increase of strength of about 1 per cent resulted from each 1 per cent increase in fineness. It was also found that 1 per cent increase in strength resulted from the use of 1 per cent more standard cement and that the increased strength gained by the use of more standard cement cost much less than when gained by using finer ground cement. The reason for this is quite evident when it is realized that the present cement of commerce is ground to within about 10 per cent of the practical ultimate fineness, and that the decrease in output of grinding mills and the increased cost of grinding grow rapidly greater as we increase the fineness toward this ultimate. All such questions have an economic bearing and while increased fineness is recognized as an ultimate refinement, there appear to be other matters pertaining to its use, requiring more immediate attention.

The experiments show that a variation of over 100 per cent frequently results in strength of concrete from variation in the quantity of mixing water used, while variations of almost equal importance follow changes in the quality and proportion of the aggregates, in the time and manner of mixing, and in methods of placing, handling, protecting, etc.

It must appear evident that the additional cost of grinding at extreme limits is so great that it will only be justified as an extreme refinement in cement making, after the practice of using cement in concrete has been brought to a point where the effect of such refinement will be secured in the quality of concrete.

Constitution of Cement.—Questions have also arisen as to the effect of variations in the chemical constituents of the cement. These relations are so complex that notwithstanding some fifty years of research on this problem which is capable in many of its aspects, of attack by individual chemists and experimenters, there is still much which is the subject of controversy and offers a field for a vast amount of research work.

While interesting, much of the information to be gained by such investigations must remain academic, although it must be recognized as offering possibilities for better knowledge of the material and its improvement, and its pursuit continued parallel with the more practical aspects of the subject. Portland cement to be useful must be relatively cheap, and this means ability to produce from essential materials, existing in combination with other non-essential materials, in as widely distributed locations as possible. It seems probable then that the most immediately useful research in this aspect of the problem will be the study of how portland cement, having the necessary characteristics of strength and permanence when used in concrete, may he made from as widely diverse materials as possible.

Improvements in Manufacture—Because this problem is to a large extent individual, it has heretofore been studied chiefly by individual manufacturers as applied to their individual operations. Most manufacturers while perhaps not knowing fully all and each of the complex chemical reactions and combinations which take place, yet generally understand the proportions and methods which will result in making from their particular materials a product which measures up to the standards developed by experience and research, and tested by time. The advancement and improvement in methods and processes to secure uniformity, as well as quality of product, have been steady and marked.

The process of manufacture is an exact chemical-mechanical one in which conditions must be maintained within narrow limits and with large quantities of materials.

Each plant must and does work out the best methods for handling efficiently its particular raw materials so that they may be supplied in a continuous stream of uniform and proper chemical proportions and in suitable physical condition, to furnaces in which uniform white heat temperatures must be maintained, so that the resulting clinker, of a hardness after cooling, capable of scratching glass, may by gradual reduction be brought to a fineness of at least 78 per cent through a sieve having 40,000 meshes per square inch, and exceed all the other rigid requirements of the standard cement specifications.

A considerable amount of difference of opinion in many matters relating to cement and concrete has existed because the nature of the problems presented made extremely difficult the application of methods of precision.

Public Service—In order to make effective and readily available to the cement using public, the results of the work of the Structural Materials Research Laboratory as well as to put that laboratory into practical touch with the problems of the cement user, which is necessary if laboratory work is to avoid becoming academic, there have been established by the Portland Cement Association twenty-four district offices, placed conveniently accessible to consuming centers, each in charge of a qualified district engineer supplied with a suitable trained engineering organization.

The keynote of association work has been service based upon the facts provided freely to all.

The manufacturers of portland cement found themselves making a product which was apparently simple and easy for anyone to use, and which because of its flexibility, convenience and merit was being widely adopted. Given the most perfect cement which could be made, this very convenience and ease, where not coupled with the necessary skill and knowledge, brought results which were unsatisfactory and sometimes even dangerous. The industry therefore addressed itself to the problem of directing the attention of all users to the necessity of learning how to use cement, and making readily and conveniently available, the necessary information to all inquiries. To do this, required the direc-

tion of attention to the product itself, its manifold uses, as well as its frequent abuse, and provision for the necessary organization to reach the widely distributed people in this entire country.

Attention has been directed toward those factors of concrete making in which there was the greatest need and opportunity for improvement, just as attention has been brought particularly to those forms of construction for which there existed the greatest need, and for which the material offered the greatest economic advantage.

Future Developments—As the work develops in its different lines, it is expected that it will cover all phases of the subject in greater detail, and it is hoped that the practice of concrete making will become so well understood and so perfectly carried out that further refinements will be possible in all its elements, not excluding cement. Cement is, however, probably nearer its ultimate possibilities as now apprehended than are any other elements of concrete making, but no man could today, in view of the constant advances of knowledge, say what are its ultimate possibilities.

The very existence of the cement industry and each individual manufacturer depends upon providing cement which is of high quality and suited to the conditions existing.

The average quality of concrete is improving. The knowledge of cement and cement making is improving. If the art of concrete making reaches a point where any change in portland cement is an economic advantage, if it is possible to provide such cement, it will of necessity be offered by the manufacturers.

The end sought is better and more concrete, and wider demand for portland cement by satisfied users. In this way only can the industry build soundly for the future and justify its slogan "Concrete for Permanence."

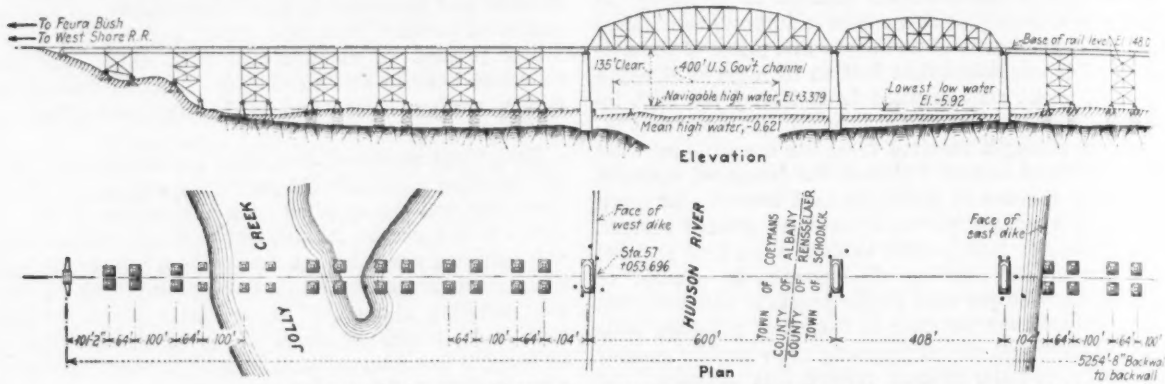
Automobiles in France

In France, according to information sent to the Department of Commerce from Paris by J. F. Butler, assistant commercial attaché, there are 202,500 automobiles, or one car to every 205 persons, as compared with 10,500,000 automobiles in the United States, or one to every 11 persons. Owing to the high initial cost and the great expense of upkeep, the ownership of even the lowest-priced automobile is beyond the means of the great mass of French people. A popular low-priced automobile of French make costs about 14,000 francs.

Castleton Bridge Contracts Let

Long-Deferred Railway Cutoff Crossing Over Hudson River Taken in Hand—River Spans 600 and 400 Feet

AFTER a postponement of nearly ten years since the beginning of the project, the New York Central R.R. has let contracts for the construction of the bypass or cutoff line around Albany and Schenectady which includes the much discussed high-level bridge across the Hudson River at Castleton, N. Y. Difficulties of financing due to the war followed a period of opposition by Albany and New York State interests, who by state legislation and lawsuits endeavored to compel the construction of a single-span structure more than 1,100 ft. long between main piers. An outline of some factors in the bridge controversy will be found in



CASTLETON CROSSING, SECOND BRIDGE OVER THE HUDSON RIVER BELOW ALBANY, WILL

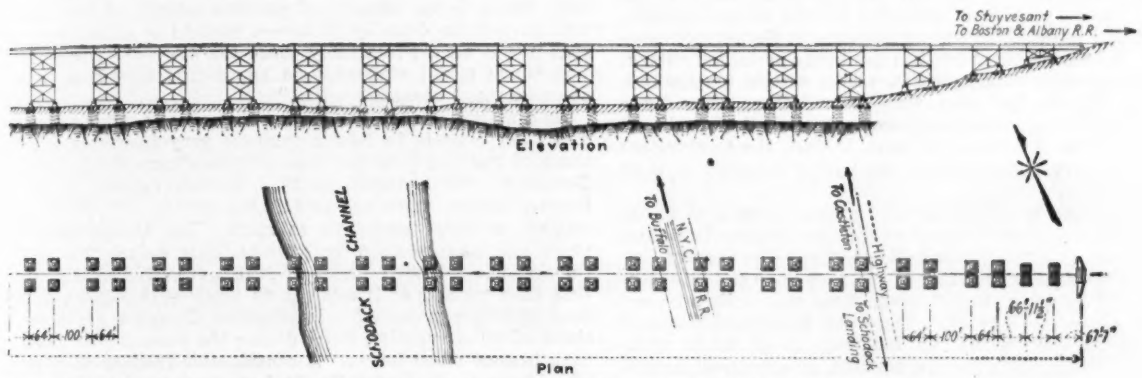
Engineering News-Record of May 30, 1918, p. 1033, while the railway project as a whole was fully outlined in *Engineering Record* of Feb. 24, 1917, p. 312. The project as described in the last mentioned reference has now been taken in hand actively. Contracts for the construction of the 12-mile railway connection have been let to the Walsh Construction Co., of Syracuse, N. Y., whose work will include building the piers and abutments for the bridge. The superstructure of the bridge will be furnished and erected by the McClintic-Marshall Co. of Pittsburgh.

Briefly outlined, the cutoff will connect the New York Central lines on the east bank of the Hudson at a point about 10 miles below Albany with the main line of the West Shore R.R. (a New York Central property) west of the Hudson, and by way of the latter line will pass to the south of Schenectady, reaching the main line of the New York Central proper by means of connections located near Schenectady. By this means both Boston and (ultimately) New York, through freight traffic will avoid the heavy grades and congested yard trackage between Albany and Schenectady, where the grades are 1.63 and 0.75 per cent against westbound and eastbound traffic respectively; the ruling grades of the Castleton cutoff will be 0.35 and 0.60 per cent respectively. In addition, several miles of distance will be saved. The cutoff makes connection with the present Boston & Albany line at Post Road, 4½ miles east of the Hudson River, and with the West Shore R.R. at Feura Bush about 7 miles west of the Hudson.

The finally adopted plan for the bridge follows closely the railroad company's original sketch design for the

crossing. This part of the line is shown in the accompanying drawing. The river is crossed by a channel span of 601 ft. 6 in. center to center of piers, and a side span of 409 ft. 2 in., both simple truss spans. Long viaducts on either end make connection with the high ground. The total length of the structure between abutment backwalls is almost exactly a mile (5,354 ft. 8 in.). The clearance height of the river spans is 135 ft. above high water, and the track grade across the entire structure is level.

Some General Design Problems—Because of the magnitude of the structure, well represented by the figure of 23,000 tons for the steel weight of the superstructure as contracted for, questions of economy and permanence of service assumed special importance. The demand of Albany interests for a clear span between dikes, for example, would have brought the total weight of the structure up to 41,300 tons, only a little less than double the weight of the structure as it is being built; this figure was computed for a cantilever of 1,130-ft. main span and 1,748 ft. total length, together with the necessary approach viaducts.



HAVE 600 AND 400-FT. RIVER SPANS FLANKED BY LONG STEEL APPROACH VIADUCTS

For the viaduct portions, both concrete and steel construction were investigated by detail designs. Under price conditions existing some years ago a reinforced-concrete viaduct compared favorably with a steel design, but under present conditions a steel viaduct is most economical. The height of this viaduct dictated the use of the longest practicable spans, so that 64-ft. tower spans and 100-ft. intermediate spans were decided upon. Each pair of spans will form an independent unit with respect to stability and expansion. Where the pedestals for the viaduct towers are in the valley bottom they are to be founded on piles to rock, which is 30 to 50 ft. below the surface, but the piers on the slopes will have direct soil footings.

The viaduct superstructure consists of four lines of deck plate girder, carrying a ballast floor on reinforced-concrete floor slab. The main objective in the adoption of the solid floor was protection of the steelwork from brine drippings. It was believed specially important in the case of this particular structure to minimize all abnormal corrosive influences, in view of the difficulty of repair or replacement at such height above ground and with the span lengths used. With the adoption of a solid floor, ballast bedding for the track followed as a matter of course.

For the two long truss spans, however, solid floor construction was considered to involve too great an increase in dead weight. An open floor of ties resting directly on the stringers will be used here. The main truss members are not exposed to corrosion from brine drip, and repair of damaged floor parts is practicable.

Curved-chord trusses with subdivided web system have been adopted for these spans. The panel length is about 33 ft. Full riveted construction will be used.

Main Piers—For the main piers, stone facing and concrete core will be used in the shafts, and these will rest on pneumatic caisson foundations. Transverse reinforcement in the concrete is provided by the plans, and at intervals of several courses the face stones will be tied in by anchor rods extending from face to face course through the concrete core.

Designs for the bridge have been worked out by H. T. Welty, engineer of structures, New York Central R.R., with advisory assistance of Olaf Hoff, consulting engineer. G. L. Taylor, chief engineer, McClintic-Marshall Co., is directing the detail design for the fabricators.

California Citizens May See City Records

The Supreme Court of California has decided that practically all municipal records in that state must be open to reasonable public inspection. (*California Decisions*, Dec. 20, 1921, p. 630.) The decision was made on appeal by both parties from a lower court decision in two suits brought originally by the San Francisco Bureau of Municipal Research and by its secretary as a taxpayer, on account of having been refused access by the city engineer of San Francisco to certain engineering data relating to the Hetch Hetchy dam and water-supply project. The trial court granted a mandate to see the records. The district court of appeals upheld this decision except as to "working papers" not formally approved by the city engineer and also data turned over by the city engineer to the city attorney for his information in connection with litigation. Both parties to the suit appealed. The Supreme Court held that although the unapproved data are not "public records" in the meaning of the California statute they are "other matters" to which the public has right of access. The court also held that such "other matters" were open to citizens even if the city engineer had communicated them to the city attorney; also that the privileged or confidential character of any such communications is lost when, as in a case in point, the city engineer had already let them be examined by others—the Civic League of Improvement Clubs.

Analysis of Economic Conditions in Soviet Russia

Department of Commerce Indicates Obstacles to Recovery—Trade Awaits Investment of Foreign Capital

Although not a matter of strictly technical interest the following statement by the United States Department of Commerce on Russian trade conditions is so illuminating a statement of fact and so incisive an analysis of the economic principles involved that we present it in full for the information of the engineering profession and the construction industries.—EDITOR.

THERE seems to be some misunderstanding as to the practical character of trade agreements made with Russia by foreign governments. There is nothing in the trade treaties between Russia and England, Germany, Italy, or other countries, which permits or establishes trade with private individuals in Russia. In substance, all that the treaties really provide is authority for the Russian government itself to establish buying agencies in the several countries. To be sure, these treaties nominally permitted citizens of the countries making them, under certain restrictions, to enter Russia, but when they arrived there, they found that trade was a government monopoly, that they could not sell to private concerns, and that, in fact, the Government usually referred them back to its buying agencies in their own countries.

In view of the fact that the total present imports of Soviet Russia are small, the interest of foreign concerns in selling goods there would necessarily lie chiefly in the hope of laying foundations for the future. No such hope can be entertained so long as the Soviet government monopolizes import trade. Under that practice there can be no establishment of business connections, no building up of trade reputation. Within the past few months, co-operative institutions, which had been converted into purely government organs, have been restored to some measure of independence, and have been given limited rights to engage in foreign trade at the same offices as the Soviet government. Still more recently importation of some agricultural implements has been permitted to private Russian individuals. The great bulk of foreign trade, however, remains in the hands of government organs.

Uniformed persons often speak of the so-called blockade maintained against Russia. As a matter of fact, for two years time now no such blockade has existed. The real blockade on trade, not only with us, but with all the world, is that maintained by the Soviet government itself. By its monopoly of commerce, it has hampered the export even of the small quantities of goods which were available and has discouraged the production of more goods. Our government puts no obstacles whatever upon selling to Russia. One result has been that even in countries having trade agreements no merchants have been able to establish themselves in Russia or to undertake manufacturing enterprises.

The trade of Russia today consists of importing goods and paying out gold from the old Imperial reserve. She can not pay for commodities by commodities. The magnitude of these gold-bought imports has been much less than many seem to suppose. According to official Soviet statistics, the 1921 imports were valued at 248 million gold rubles, or approximately $125,000,000. This is only one-sixth of the prewar imports. Exports amounted to the sum of $10,000,000 (20,283,000 gold rubles); in 1913 they were 75 times as great. These exports consisted largely, and probably chiefly, of commodities left over from the pre-Bolshevik regime. The difficulty of exchange of commodities is evident from the fact that before the war, two-thirds of Russia's exports in value were foodstuffs, while today the country is in the throes of a terrific famine and a large part of its imports are foodstuffs. In February, two-thirds, in weight, (values not yet available), of Russian imports were foodstuffs, the larger part of which were furnished by the charity of the American people.

There is little prospect that Russia will have any more to export in 1922 than she had in 1921. Meantime, the gold reserve is approaching exhaustion and with it is disappearing what might have furnished a start toward reëstablishing a workable currency. The paper money of Russia is hastening to the ultimate catastrophe of utter unacceptability within the country itself. The recent attempt of the Bolshevik leaders to restore something resembling individualistic methods in the conduct of industry, and particularly by payment of wages in money instead of a communistic division of commodities in the form of rations to the workers, has itself hastened the currency debacle. There being a fundamental shortage of foodstuffs and other necessaries, wages paid in money naturally can not buy enough to support life. Prices soar and though wages are multiplied by constant emissions they can not catch up with "galloping prices," as a leading Bolshevik journal calls them. Prices in Moscow now are doubling every month, which means multiplying 4,000 times in a year. A day's ration of food cost, in April, a million rubles. The time must apparently come soon when paper money will no longer buy. Then, in the absence of precious metals, all business will have to be done by barter—a method so cumbersome that it will almost inevitably check the increase of production which might otherwise be hoped to follow from the so-called "new economic policy."

As a matter of fact, despite the absence of a trade agreement, our exports to Russia compare very favorably with those of our two principal competitors—Great Britain and Germany. For example, in 1913, British exports to the Russian empire amounted to $135,000,000; in 1921, to $33,500,000, or only one-fourth as much. The United States never had a large share in Russian trade before the war. Our exports to that country in 1913 were $27,000,000. In 1921 they were over two-thirds as much—$19,257,000, and most of this represented sale of goods, though a part consisted of relief supplies, which during the present year 1922, have become much larger. A considerable fraction of British shipments to Soviet Russia last year consisted of reexported foodstuffs, and these, if they did not come directly from the United States, virtually created a demand for the equivalent quantity from this country. The British have been grievously disappointed in the results of their trade treaty. Much had been made of the enormous needs of the huge Russian population so long deprived of goods. It was forgotten that need for goods does not constitute demand for goods. Demand implies ability to produce and pay.

The really important problem confronting American business men with respect to Russia is not that of trade but that of investment. Without a large investment of foreign capital as a means of restoring production, the prospects are that, at least for some years to come, there will be even less opportunity to sell goods to Russia than in 1921, for with the exhaustion of the gold reserves, her means of payment will shrink to a minimum. The feasibility of investing capital in Russia depends essentially on the policy of the Bolshevik government and on the general internal situation, and not upon action of foreign governments.

Concrete Ships in England

The London *Times* notes that the fleet of 1,000-ton sea-going barges and steam-tugs, built in concrete for the Ministry of Shipping during the last stages of the war, has been purchased by a shipping firm whose intention is to employ the vessels for the transport of coal from Newcastle to London. In spite of the structural success of concrete ships and the thoroughly satisfactory record of the "Armistice," the only British-built concrete cargo steamship, the concrete shipbuilding industry seems to be extinct in Great Britain, according to the *Times*. The cost of construction under government auspices was far too high, the numerous yards established have been closed down on terms satisfactory to their former owners, and most of the firms concerned have reverted to their original occupation of public works contracting.

Public Roads Bureau to Expand Research Program

A COMPREHENSIVE program of road-building research during the coming season at the Arlington Experimental Station near Washington, D. C., is announced by the U. S. Bureau of Public Roads. Impact tests on pavements, subgrade studies and other experiments conducted last year will be continued and new investigations will be started.

Bituminous wearing surfaces are to be investigated to determine the reason for the formation of waves, proper mixture and the proper mineral aggregates. More than 30 sections of different types of bituminous construction will be built on a circular track about 600 ft. in circumference, the roadway being 13 ft. wide,

COMPLETED BASE FOR TEST OF BITUMINOUS SURFACES
The rails mounted on the small concrete piers are to be used to guide the truck automatically.

On this roadway a 5-ton army truck, with solid tires, will be operated in a varying path so as to cover practically the entire width of the roadway and will travel at a speed of from 12 to 15 miles an hour for five or six months, or until some results are obtained leading to the solution of the problems involved.

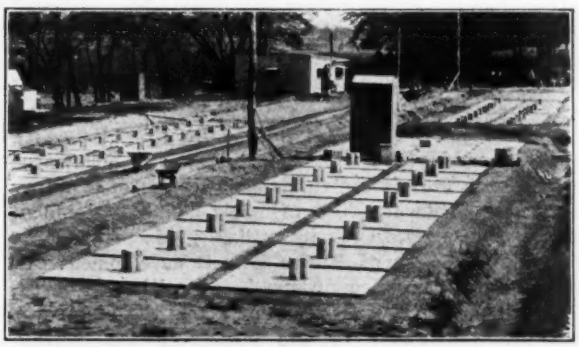
Resistance to Wear—At present the selection of concrete aggregates for the greatest amount of resistance to wear is based on wear tests made in the laboratory, upon the compressive strength of concrete, and upon the structural strength of concrete beams constructed and broken in the laboratory. The comparison of the wear of concrete in actual use on road surfaces with the indications obtained in laboratory experiments is not wholly satisfactory.

To throw more light on this subject a wear test is to be made with the conditions approximating those actually found on the road. This test will include about 65 sections of concrete wearing surface to be constructed on a circular runway about 650 ft. in circumference, the runway being 4 ft. wide. On this runway will be operated a specially constructed car with two truck wheels equipped with solid-rubber tires and loaded to represent a truck. The car will be guided by small railroad rails to hold it in position, the power being applied by means of an electric motor to the rear wheel. This apparatus will be operated around the circular runway at a speed of probably 20 miles an hour. The test will involve the use of truck wheels equipped with different kinds of tires and will include the use of non-skid chains. A steel-tired wheel will probably also be used to get the effect of an accelerated wear test. This test will be in operation continuously.

Impact on Roads Studied—The effect of impact on concrete pavements and several types of road on concrete base was studied and reported on last year; this series of experiments is to be continued and enlarged. Over 120 road slabs have been constructed in duplicate series. One series is on a carefully drained dry subgrade; the other series is on the same kind of subgrade except that it is kept wet and as nearly saturated as possible by means of an underlying drain tile and side ditches filled with water.

The testing of these slabs will be by means of a new impact machine which simulates the action of the rear wheel of a truck. On this machine may be mounted truck wheels of different sizes and weights carrying different kinds of truck tires. The slabs will be hammered by means of this machine in the center, on the corners and on the sides, so as to obtain the relative strength under these different conditions.

Subsoil investigations are being continued for the purpose of studying and investigating relative stability, moisture condition, and supporting value. Different methods of determining the bearing value of soils are



CONCRETE SLABS FOR IMPACT TESTS
The cylinders are for compression tests being cured under the same conditions as the slabs.

also being studied, that is, as to whether small or large areas should be used in determining the relative bearing value.

The warping effect of temperature and moisture conditions on concrete pavements is also being investigated. Temperatures and movement are being recorded graphically on continuous charts. In addition the pressures on the subgrade under the concrete slab are obtained by means of soil pressure cells. This investigation, which has been under way for some time and will continue probably for a year or more, will give definite information concerning the support offered by subgrades to rigid concrete roads.

The transmission of loads through different types of pavements to the subgrade is being investigated by means of soil-pressure cells placed on the subgrade under the pavements. This test will also serve to show the relative support offered to brick and other types of block pavement by concrete bases and broken-stone bases. This investigation has been under way for about one year and will continue.

It is intended to have all these projects in full operation by the middle of June. Visitors are always welcome and those in charge of the work are always glad to give any information desired about the experiments.

Papers and Discussions on City Planning

Abstracts of the More Important Proceedings of the National Conference on City Planning at Springfield, Mass., June 5-7

Fundamentals of Transit Planning For Cities

By Daniel L. Turner

Consulting Engineer to the Transit Commission of New York City

FROM a transit standpoint, our cities are planned today very nearly as they were planned 100 years ago, when people were living in a man-and-horse civilization. If a street system in a small town to properly function as a circulating and distributing medium must practically traverse the town in all directions in a lattice-like fashion, how much more necessary is it for the street railway system. When street railway transit superseded foot transit then the street railway system rather than the street system should have been accepted as the principal circulating medium of the town, and the town should have been planned and constructed accordingly. But this was never done, and is not being done even now.

When Transit Facilities Should Be Provided—City transit should precede the population—not follow the population. This is the fundamental basis of a proper transit development. The principle cannot be emphasized too strongly. Only by utilizing this principle as the guiding policy of future transit development can the existing transit conditions in our cities be cured. This principle of transit development is the reverse of that followed under private ownership and private operation. Expressed in another way, the principle means providing transit service for the whole city area —not for the traffic immediately in sight—not for profits primarily.

Providing transit in advance of the population means that when it becomes necessary to open up a new area for the growing population, the transit system and the street system should spread out over the new territory simultaneously; the two systems should expand together. Then the other services, such as water, sewers and light, can follow.

Convenience of Access—It may be assumed that a city will be conveniently served if a prospective passenger is not required to walk more than a quarter of a mile—or walk longer than five minutes to reach a surface line, either a motor-bus line or a street railway line, routing towards the business center, which is the objective point for most of the traffic. This means that the lines would be about a half a mile apart in the residential districts. For crosstown service, lines one mile apart will conveniently serve the community.

In the case of subway or elevated lines, that is rapid transit lines, if the lines routing to and from the center are one mile apart, and the crosstown lines are two miles apart, convenient rapid transit service will be afforded the community; every one could reach a rapid transit line within a 10-minute walk. The surface lines and the rapid transit lines would route closer together than described above as they approach the business center, to the extent of traversing every street in extreme cases.

Routes—A study of most of the larger cities indicates that they conform closely to the semi-circular shape and can be included within a 6-mile radius. For this reason an analysis of the route mileage standard can be based on the theoretically semi-circular city. Such a semi-circular city of one mile radius contains an area of approximately 1,000 acres, and the area increases as the square of the radius; so, squaring the radius in miles and multiplying by 1,000 will produce the approximate acreage of any semi-circular city.

Upon this basis, it would require approximately one mile of motor-bus or street railway line, or route, for every 200 acres of city area. In the case of a single track, with the average sidings, this would reduce to one mile of single track for every 180 acres; or in the case of a double-track line (neglecting yards, etc.), one mile of track for every 100 acres. Usually the acreage served by one mile of track should be between these limits.

For rapid transit lines the corresponding standards are: One mile of rapid transit route for every 400 acres of city area; and one mile of rapid transit track for every 200 acres of city area, assuming a two-track line.

For motor-bus lines and surface car lines approximately the number of routes can be obtained by extracting the square root of the city acreage and dividing by 6.3. For rapid transit lines, the square root of the city acreage divided by 12.6 will give the number of routes approximately.

The routes should be distributed throughout the city so as to furnish the same character of service to all sections. The up-and-downtown routes should be as direct as possible. Their function is to provide quick transportation between home and work. As far as practicable, up-and-downtown routes serving opposite sides of the city should traverse the business center cross-town-wise through the same street. In this way one pair of tracks in the congested area would accommodate two pairs serving opposite residential sections; that is, for every four outlying tracks only two tracks would be required through the business center. In the morning and at night both such tracks would be utilized by loaded cars with workward-bound passengers in the morning and homeward-bound passengers at night. This constitutes the development of a two-way traffic through the business center and consequently is the most economical use of the streets within the congested area.

Ideally arranged, the central pair of up-and-down routes would penetrate farthest downtown, across all of the cross-wise business streets, except the one nearest the water-front, which would be traversed by the cross-town connection for two-way traffic above described. Thus the movement of the cars would be along a U-shaped route downtown on one side, across-town

through the business center and then up-town on the other side. The pair of routes next removed and on either side of the central pair would continue downtown as before across all of the crosswise streets to next to the last one. (This U-shaped arrangement would be continued as needed, the U having a continually wider spread and the bottom higher up.) With this route arrangement a passenger could reach almost any point in the business section by one transfer from his own up-and-down line.

The cross-town lines are for a different purpose. They will be used by transfer passengers chiefly. They should run directly across town and thus intersect all up-and-down lines. Their function is to articulate the entire railway system. By means of them a passenger will be able to reach any point in the city from any other point.

Necessity for Municipal Ownership—Municipal ownership is essential if city transit facilities are to be developed and utilized in the best public interest. Of course, this means municipal ownership with proper planning. Municipal ownership and municipal operation are two separate and distinct things. Do not confuse them. We can have municipal ownership without having municipal operation. We are ready for municipal ownership now, but we are not yet ready for municipal operation—the price is too high—that remains for the future in the natural process of evolution.

In preparing for the extension of any city, the streets should be laid out, graded, sewered, water supplied, and paved, beforehand in order to induce the population to follow. These things are all appurtenances of a street system and are recognized municipal functions. We should not wait for the population to accumulate and then build the streets and their appurtenances. But transit lines are really moving streets—or at least they are street appurtenances. Therefore it is even more important that we should not wait for the population to accumulate before constructing the necessary transit lines. Yet, this is the policy the operating companies would have us adopt in the case of transit lines when they own and control them. They are averse to developing new territory. The traffic returns from such territory would be too lean. They are after the fat only. They contend that municipal transportation should not be furnished to a community until there is a population ready to be served. They insist that it is better to follow old lines of travel than to create new ones. They would parallel already congested lines by new facilities, instead of deflecting the new facilities into undeveloped territory.

From the viewpoint of the operating companies, with profits the primary consideration, the correctness of the principles just described cannot be disputed. Such principles have served as the guiding policy in the past, and have produced the transit conditions which now prevail. If the same principles are to control in the future, then the present transit condition will be the public's portion for all time in our cities.

The transit facilities required in our largest cities today to properly accommodate the public not only include the rapid transit lines, but they also include the surface car lines and the bus lines. All of these facilities are a necessary and desirable part of the transit program.

Consolidated Operation—Everybody should be served alike with transit facilities wherever he may work and wherever he may live. Therefore, everybody should be able to utilize all the facilities necessary to carry him from his home to his work for a single fare—either bus lines, surface car lines, or rapid transit lines, separately or in combination. This end can only be attained under a system of universal transfer, and under a system which utilizes all of the facilities coordinated under a general plan. A single operating company can best perform this service. Therefore, monopoly of operation is desirable.

As between municipal operation and private operation there can only be one answer, as I can see it. The public cannot yet perform any function as cheaply as a private company can do so. Public employees cannot be held under the same strict discipline that can be exercised over private employees. Under present political conditions, it would be impossible to keep municipal operation free from political dictation and domination. At the present state of civil development, municipal operation to me, is unthinkable. The only alternative is private operation under public control, a control aimed to insure a service for the whole public that is convenient, adequate and safe.

The most desirable things to be achieved in transit development in the public interest, such as new facilities when needed, of a suitable type, and properly distributed throughout the city, can all be satisfactorily accomplished under municipal ownership without resort to municipal operation.

* * *

Street System Design in Relation To Vehicular Traffic

By Ernest R. Goodrich

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In the study of the district centering in Springfield, Mass., the following conclusions as to the design of street systems have been arrived at:

1. Vehicular traffic is found to vary in amount at the business point in a community in proportion to its size.

2. The total radial street traffic at equal distances from large communities of varying size is proportional to the population of each community.

3. The total radial street traffic at different distances from the center of each community varies inversely as the distance from the center.

4. A definite relationship exists between the amount of through traffic and the total number of automobiles licensed in that part of the country in which the community is located.

5. Through traffic may be expected to vary in the future in proportion to the degree of saturation of automobile ownership.

6. The amount of vehicular traffic originating in, and destined to residential districts is today approximately one vehicle per day per family.

7. Vehicular traffic from and to freight stations bears a definite ratio to the population and its proportion employed in industry, depending to some extent upon the dominating types of manufacture.

8. The amount of vehicular traffic created by industry may be closely approximated on a square foot basis of land and of floor space thus employed.

9. An industrial survey is the best method of approaching the station of a city plan because it will provide data on the basis of which the future use of the streets can be estimated.

10. A zoning ordinance will definitely limit the amount

of street traffic and provide the basis upon which it may be estimated.

11. The growth of communities shows that a general law is followed upon the basis of which estimates of future population can be made with considerable precision.

12. Cities will grow to a definite size depending in large measure upon the distance to larger surrounding communities.

13. The distribution of future population throughout a community can be closely estimated on the basis of the law of growth, the limit set by the zoning ordinance, topography, and social conditions which the community can establish.

14. In general, the density of population varies inversely as the distance from the center of a community.

15. The traffic during the maximum hour of the day varies from 115 to 140 per cent of the average hour.

16. The traffic during the maximum week is approximately double the average of the year.

17. Roadway widths should be designed on the basis of the number of lines of traffic which they must handle.

18. Traffic conditions at intersections limit the number of vehicles per line per hour to a maximum of about 600.

19. The main thoroughfares in single family residence districts should be spaced not to exceed 3,000 ft. apart; 2,000 ft. in two-family house districts and 1,250 ft. in multi-family house districts.

20. In industrial districts the main thoroughfares should not be spaced more than 750 ft. apart.

21. The total number of radiating streets which should be provided in any community can be determined on the basis of the amount of traffic which is to be expected.

22. The total width of the roadways of radiating streets can be determined on the basis of the traffic which must be carried.

23. The area allocated to zones for different uses in a community can be determined on a scientific basis.

24. The whole street transportation and street design problem can be worked out on a scientific basis.

* * *

Shorter Abstracts

Parks and Playgrounds—Henry V. Hubbard, School of Landscape Architecture, Harvard University: Playgrounds for small children under five years of age require 16 to 18 sq.ft. per child and for children up to 12 years, 140 sq.ft. Playfields require 4 to 6 acres each. There is a tradition that 10 per cent of the total area of the city should be devoted to parks. Playgrounds and small parks have little influence on the street layout of the city but the larger parks do. As a rule, automobiles should carry people by rather than through parks, but they may go to parks and through reservations.

School Buildings and the City Plan—George G. Strayer, Teachers' College, Columbia University: In 1921 school bond issues totaled $240,000,000. An issue of $2,000,000,000 would *partly* eliminate unfit school buildings of the country. Elementary schools may draw pupils from a radius of ½ mile; junior high schools, from 2 to 3 miles. High school locations should be governed by the availability of sites, so as to provide ample grounds. They may be in outlying districts, where land is inexpensive and the pupils will be going outward on trolley lines at a time when business traffic is inward. In the outer districts, sites of 10 to 40 acres, exclusive of the land occupied by buildings, may be provided, the area depending upon the prospective tributary populations, which snould be made a matter of study. Discussion: Several speakers endorsed the idea of large school sites, selected in outlying sections. At Gary, Ind., school site areas were increased from 10 to 12 acres, then to 20, 25 and 34 acres, the latter including a stadium.

River Front Treatment—Col. Stanhope E. Blunt, President Park Board, Springfield, Mass., reviewed the experiences of that city with relation to the railway tracks along the river and efforts to eliminate them or reduce their number particularly in connection with the plans for the bridge over the Connecticut now nearing completion. At one time the New Haven R.R. would have agreed to a plan under which all but two through tracks would have been located across the river but criticism and opposition were fatal. Some of the river front has been parked but most of it is occupied by tracks, up to as high as fifteen.

Place of the Beautiful in the City Plan—John Nolan, Cambridge, Mass.: American towns and cities, if they are to fulfill their purpose, must be beautiful. This they cannot be without a city plan. Beauty is achieved largely through works of landscape architecture, architecture, sculpture and engineering, but these must be placed under conditions that can be made possible only by a city plan which provides location, elevation or gradient, the foreground and background, the vistas, balance, scale, broad relationships, the environment and the opportunity for placing and assembling the works indicated, under conditions that render them truly and permanently beautiful. Andrew W. Crawford, president of the Municipal Art Jury of Philadelphia, a second speaker on this part of the program, said that art does not consist of ornament, but of design. The Philadelphia Art Jury, in passing on plans for public structures, has often cut out ornament and saved the city expense.

Winning Support of Planning Programs—Dr. Samuel B. Woodward, Chairman City Plan Committee, Worcester, Mass., and C. J. Hamlin, Buffalo, N. Y., described methods employed in securing public interest in and support for city planning, including private subscriptions in each case to launch the work. At Buffalo a comprehensive persistent campaign was carried on which included mailing thousands of copies of a series of bulletins to a list selected with aid of civic, social, commercial, political and other organizations.

Canadian Bridge Specifications Revised

A revised edition of the standard specifications for steel railway bridges of the Canadian Engineering Standards Association, the first edition of which was issued two years ago (see *Engineering News-Record*, Dec. 16, 1920, p. 1199), has just been published. The revision was carried out by the sub-committee on steel railway bridges (ch., P. B. Motley) of the sectional committee on steel bridges and construction (ch., G. H. Duggan). The part of the original specifications dealing with movable bridges has been eliminated, so as to prepare for a separate issue of a specification on movable bridges. On the other hand a section covering erection has been added. Various clauses have been modified in more or less minor ways. Painting has been covered more definitely than in the earlier issue. The parabolic column formula of the original edition has been abandoned in favor of the straight-line formula of the American Railway Engineering Association. It is stated, incidentally, that the revision was carried out in consultation with the bridge departments of the three Canadian railways.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Civil Engineering as a Career

THE YOUNG MAN AND CIVIL ENGINEERING—By George Fillmore Swain, Gordon McKay Professor of Civil Engineering in Harvard University; Past-President of the American Society of Civil Engineers; formerly Chairman of the Boston Transit Commission, etc.; Consulting Engineer. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 203. $2.

To give a broad picture of the civil engineering field, to paint its future and its attractions, to make clear the abilities it requires if one is to be successful in it, are not easy tasks. They call for enthusiasm and at the same time restraint; they require knowledge of and sympathy with young men. Prof. Swain has done the job well. Here will be found a clear picture of the field of civil engineering, together with wise counsel to those who consider entering it.

After an introductory chapter defining the scope of the profession, there are chapters on the branches of civil engineering, on the qualifications needed, on the education of the civil engineer, on the characteristics of civil engineering as a profession, and on the outlook. A concluding chapter is a fatherly talk to the young fellows on the qualities that contribute to success in an engineering, or in any other, career.

The first chapter is an excellent treatise on the scope of engineering and its civil branch, somewhat heavy for the young fellow, but illuminating and helpful. In it Prof. Swain, after pointing to the deficiencies of other attempts, suggests a definition of engineering, as follows: "Engineering is the science and art of applying economically, the laws, forces, and materials of nature, for the use, convenience or enjoyment of man." In discussing the definition he lays emphasis particularly on the inclusion of both the words "science" and "art" and of the word "economically."

The chapters on education and on the characteristics of civil engineering as a profession are particularly well done and will make good reading not only for the young men and their parents, but for practising engineers as well. In discussing education Prof. Swain upbraids the liberal arts colleges for their emphasis on superficial "culture" to the neglect of the mental discipline which should be the aim of a college course. On the other hand, while he commends the disciplinary character of engineering curricula, he shows that they properly contain such broadening subjects as languages and history.

Nor does he, in a later chapter, save some of the fellow professions. As a means of emphasizing, by contrast, the characteristics of civil engineering he deals pretty harshly with the doctors and lawyers, and points out some of the sore temptations which lead men in these professions astray.

On the matter of compensation his discussion is brief. It might with advantage have been extended, even though it is well to deter any young man from selecting a career on the basis of probable financial return. He rightly points out that there are other compensations than mere money. In fact, he does not fail in any chapter to impress on the young man the satisfaction which comes with doing well the big construction jobs which contribute to man's welfare. Long before Prof. Swain comes to the matter of compensation, the young reader will have got a clear vision of the breadth and attractiveness of civil engineering. If he then reads Prof. Swain's comments on compensation with the feeling that the advantages of this career are overcome by the relatively low average financial return, he is probably not a man who would be happy in civil engineering work.

If we would offer criticism, it would be that the tendency of the book is to be thorough—not more thorough than the subject deserves, but more thorough than the average young man (we ought to say "boy") wants. The young man, though, who is looking seriously at the possibilities of civil engineering as a career will have his questions well answered by Prof. Swain.

Notable British City Planning Studies

LONDON OF THE FUTURE—By the London Society Under the Editorship of Sir Acton Webb, K.C.V.O., C.B., P.R.A. New York: E. P. Dutton & Co. Cloth; 8 x 11 in.; pp. 286; plates of halftones and diagrams. $15.

Ten years ago the London Society was organized "to interest Londoners in London" and to bring an intelligent public opinion to bear upon the local and Imperial governments to the end that "a large view" may be taken "of London as a whole." It was not expected that all the needs of Greater London could be met at once, but it was hoped that the authorities might be led to "see the importance" of doing whatever may be done as "part of one great scheme, and so give a unity and completeness to London improvements of the future which has been denied to her in the past." The work of the society, although interrupted by the war, has borne fruit through its leadership when great plans for public improvements have been under discussion, and in the series of important studies included in this handsome and stimulating volume. The book is well designed to arouse interest in planning for the future London and adjacent territory. It should also further the cause of city and regional planning throughout the world.

Seventeen large city and regional planning problems are discussed by as many writers, most of whom have specialized in their respective fields. These studies are briefly summarized in an introductory chapter by Sir Acton Webb, chairman of the council of the London Society. Some of the chapter titles and authors are: Roads, Streets and Traffic of London, by Col. R. C. Hellard, formerly superintendent of the London Traffic Branch of the (British) Board of Trade; London Railway Reconstruction, by H. J. Leaning; the Bridges of London, by Sir Reginald Blomfield; the Channel Tunnel, by Sir Arthur Fell, chairman of the House of Commons Tunnel Committee; Central London, by S. D. Adshead, Professor of Town Planning at London University; and Some Thoughts on the Development of London, by Raymond Unwin, chief town planning inspector, Ministry of Health. Among the other subjects treated are commercial aviation, the port of London, housing, parks,

smoke abatement and the government of London—the latter being a controlling factor in city planning on account of "the complex machinery" of the Administrative County of London and its component two cities and 27 boroughs, to say nothing of "water," "police," and "Greater" London.

The absence of a chapter on zoning—the word does not appear in the index, although the principle is mentioned once or twice with emphasis—seems strange in view of the large amount of practical work done in that field in America.

Altogether, the volume is a notable contribution to city planning literature. It illustrates anew that much, if not most, of at least the preliminary city planning studies for a large city or group of cities must be undertaken privately until our city and central governments realize the urgency of providing adequate city and regional plans.

From Huntington to Harriman

CHAPTERS ON THE HISTORY OF THE SOUTHERN PACIFIC —By Stuart Daggett, Ph.D., Professor of Railway Economics and Dean of the College of Commerce, University of California; Author of "Railroad Reorganization." New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 470; frontispiece. $5.

In view of the recent litigation in the United States Supreme Court concerning the relationship between the Central Pacific and the Southern Pacific Railroads, Prof. Daggett's historical study has a special interest. Besides this, it is illustrative of a kind of literature that has but recently come to the fore and that has yet to attain its deserved standing. With the development of American industry, especially in those departments that have the appeal of pioneer enterprise, are bound up many stories quite as interesting as the biographies of outstanding individuals. There is ample material and a genuine need for the "business biography" as a distinct department of literature.

It is true that in one form or another the stories behind many of our foremost industries have been told, and in some cases, retold. Unfortunately, these have usually been written from a partisan viewpoint. Some have aimed to glorify, or if necessary, to excuse the builders of the industry. Others have sought to attack their reputations and to descredit them. What is needed is the work of scholarship that will regard these developments dispassionately as human efforts to solve social and economic problems and that will bring to the telling of the story an ability to preserve that flavor of human interest which makes its palatable to the general reader. Although Prof. Daggett has had to deal with a subject notably difficult in spots, he has succeeded in tempering his judicial findings of fact with a fair measure of the story-teller's lure.

Engineers will be particularly interested in the earlier part of the story. There they will learn that the promoter of the Central Pacific R.R., the percursor of the Southern Pacific System, was a young engineer, Theodore Dehone Judah, who was a native of Bridgeport, Conn. In 1854 at the age of 28 he went to California. Becoming possessed with the idea of a transcontinental railway, Judah hammered incessantly at the mountains in search of a practicable pass. The one finally adopted appears to have been discovered as a result of collaboration between Judah and, strangely enough, a druggist of Dutch Flat. After he had determined upon a route he organized a company and set out to sell it. He tackled San Francisco and failed. Then he went to Sacramento where he seems to have encountered the traditional businessman's attitude that he might be a good *engineer*, but—

Eventually, he met Collis P. Huntington, Leland Stanford, Charles Crocker, and Mark Hopkins. Huntington, too, had been born in Connecticut and had worked his way out to California via the Isthmus. He was the dominating genius of the four who eventually put through the Central Pacific and Southern Pacific projects. Stanford had been a New York lawyer and was the politician of the four. Crocker had been a little of everything—peddler, iron maker, gold miner, and trader. His strong point was the handling of men. It was Crocker who drove through the work of construction. Hopkins was the inside man, the man of detail, the careful scrutinizer of contracts.

But the story of the Southern Pacific from Huntington to Harriman cannot be retold here. It is a story of far-sighted vision, of courageous enterprise, of ruthless competition, of sordid politics, of reckless finance, of heartbreaking suspense, of unscrupulous manipulation, of public exploitation, and of the early struggles of government to control a power that recognized no right of public regulation. No one can read this story without acquiring a background against which he can discern more clearly the why and wherefore of many current problems in railroad administration and regulation.

Although several maps are scattered through the book, it is unfortunate that there is not included a general map of sufficiently large scale to illustrate more of the pioneer work and to make clear the relationship that existed between the several roads that went to make up the Southern Pacific System. The only map that shows the Central Pacific and the Southern Pacific is quite small and wholly inadequate.

By and large the book is a notable contribution to business biography and will commend itself to the general reader.

A Handy Volume on Coal

COAL: Its Properties, Analysis, Classification, Geology, Extraction, Uses and Distribution—By Elwood S. Moore, Ph.D., Professor of Geology and Dean of the School of Mines of the Pennsylvania State College. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6 x 9 in.; pp. 462; illustrated. $5 (25s. net).

Just now, with the miners' strike occupying some share of the public attention, an informative book on coal is likely to command the interest of the general reader provided it is so aimed as not to shoot over his head. Such a volume lies before us. It has been prepared, says the author, in an attempt to satisfy the demand for a handy volume on coal. This it appears to do. Although there may be in it little that will be new to the well posted expert in the field, much of its contents will appeal to the general reader and its arrangement and treatment will doubtless contribute to its value as a class-room text. The work falls generally into three divisions, of which the first, comprising about 25 per cent of the whole, is a resumé of the physical and chemical properties of coal together with descriptions of the ordinary processes of analysis. The central portion, comprising about 50 per cent of the book, will appeal most strongly to the general reader, for it is here that the author tells of the origin of coal, the formation of its deposits, and the organization and methods involved in its mining. It describes briefly also the operation of coke and by-product ovens. The

last quarter of the book also is of general interest as it surveys the geographical distribution of the world's coal resources.

The book is well illustrated throughout by maps, charts, and photographs which supplement the text to advantage.

English Practice in Railway Earthwork

EARTHWORK IN RAILWAY ENGINEERING—By John W. F. Gardner, M. Inst. C.E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B. Sc., M. Inst. C.E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 152; 74 line cuts and pen sketches. $3.50.

Although this book is interesting and instructive on foreign practice, it is of little use as a textbook or guide for the American engineer, since it deals with conditions and methods quite different from those which obtain here.

Among the conditions foreign to American practice may be noted the following: Slopes of cuts and fills dressed by hand with the aid of templets; surfacing of slopes with black soil and turf; tracks spaced only 11 ft. c. to c.; hand excavation favored for making cuts less than 15 ft. in depth and for widening single-track cuts; end-dump cars preferred; fills built in layers 15 to 20 ft. thick. Masonry culverts are shown with stone side walls, brick arch and concrete invert, both arch and invert being lined with hard-burned blue brick. Why the arch should be thus lined is not apparent. Pipe culverts include clay, cast iron and "riveted malleable iron or steel," but no mention is made of corrugated iron or concrete pipe. Reinforced concrete, disposed of in a few lines, is said to be "now largely adopted."

Construction equipment appears to be limited in extent and to consist mainly of small units. A 4-yd. standard-gage dump car is the largest mentioned for serving steam-shovel work, and the end-dump car is considered preferable for fills less than 30 ft. in height. Construction trestles are not mentioned, but reference is made to American practice in dumping from a track carried by a cableway. Wheelbarrows and one-horse carts are mentioned as ordinary equipment, but horse work must be slow since it is stated that with the ordinary cart the horse must be detached from the shafts before the cart can be unloaded.

An excavator of the ladder-dredge type is shown, but it has been used only to a limited extent on railway work. The ladder is at right angles to the track and the buckets cut on the upward travel as they ride against the side of the cut. Large steam shovels have 3¼-yd. buckets and small revolving steam shovels have 2- to 2½-yd. buckets. No mention is made of well drills for putting down blast holes. Drag and wheel scrapers are described as American devices, but there is no mention of fresno scrapers or of graders and spreaders for leveling the fill.

For subsidence in ordinary fills an allowance of 1 in. for every foot is given, the top width being increased proportionately. As to classification, the author considers "soft material" and "rock" sufficient, since "no advantage is gained by having an intermediate class."

Preliminary chapters deal with railway location, test pits, culverts and waterways. A chapter on execution of earthwork covers plans, surveys, quantity estimates, construction railways, surface stripping and the handling of excavators and dump-car trains. The chapter on plant is of only casual interest. In discussing conditions which affect cost, the author approves of a bonus to gang foremen when the daily work exceeds a prescribed yardage, or the work may be sublet to these foremen "in order to give them a small financial interest in the work."

Finally, it may be said that a section of some practical interest to the American engineer consists of the 35 pages on slips and their prevention, roadbed drainage and the maintenance of earthwork.

A Text-Book on Land Drainage

LAND DRAINAGE—By W. L. Powers, M.S., M. Am. Soc. Agricultural Engrs., Chief in Soils, Oregon Agricultural College and Experimental Station, and T. A. H. Teeter, B. S., M. Am. Assoc. of Engineers, formerly Professor of Drainage and Irrigation Engineering. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9 x 6 in.; pp. 270; illustrated. $2.75.

Although written particularly for students in agricultural engineering, farmers and owners of wet, overflowed and alkaline lands, this book may be read with interest and profit by the drainage engineer. Briefly and in a general way it goes over a broad field. After explaining the advantages of drainage, the book deals with soils, soil water, tile drains, open ditches, levees, outlets, cement and clay tile, vertical drains, and the needs and difficulties of maintenance. Methods of ditching, trenching and pipelaying are described and cost estimates and prices of material given. An increasing demand for machinery as a result of labor shortage is noted. Drainage laws, districts, assessments and bonds are reviewed. Hydraulic data include rainfall, percolation, evaporation and the measurement of velocity and discharge. Special subjects taken up are the drainage of tidal, marsh and irrigated land, and means of preventing erosion and gullying of land. Rural sewage disposal is touched upon, since some states prohibit the discharge of raw sewage into streams. A chapter on drainage surveying rounds out the long list of subjects. References to other books and to reports and pamphlets dealing with particular features of drainage work add to the usefulness of the book.

Report on London Refuse Disposal

REFUSE DISPOSAL: Final Report of Conference of Metropolitan Borough Council. London: Harrison & Sons, Ltd., St. Martins Lane, W.C.2. Paper; 8 x 13 in.; pp. 14; 6d. net.

In remarkably small compass there is here presented an extremely valuable report on the present refuse disposal practice of the 29 cities and boroughs forming the administrative county of London. The committee was composed of four staff engineers and ten aldermen and councilmen from the several municipalities. The report may well afford a corrective to the widespread idea in America that all municipal refuse in England is put through high-temperature destructors and yields a profit from steam production and the generation of current for electric light and power stations. Although 14 of the 29 municipalities in the county of London have destructors, less than 20 per cent of the 1,500,000 long tons of refuse collected yearly is burned. Most of the remainder of the refuse (garbage, rubbish, and ashes) is disposed of by dumping. The report describes one or two of the more notable London installations which do utilize the heat and cinders produced by their destructors. It also describes new plants in and out of London for utilizing refuse by

screening, sorting and pulverizing, a combination that seems to be growing rapidly in favor in England. The conference committee expresses the belief "that the great bulk of the refuse [of London] can be converted into marketable commodities and can be sold in relief of the rates" of local taxation.

Machinery for Docks and Locks

DOCK AND LOCK MACHINERY—By W. Henry Hunter, M. Inst. C. E., M. Am. Soc. C. E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B.Sc., M. Inst. C. E., Professor of Civil Engineering in the Royal Technical College, Glagow]. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; 97 cuts and pen sketches. $4.50.

Very little has been printed in book form in this country on dock and lock machinery; so that this book should be welcomed by the fairly limited number of engineers engaged in this sort of design. Mr. Hunter was one of the world's greatest harbor and canal engineers and his work at Manchester alone would have qualified him for the task of writing the book. In addition, he had an appreciation of the necessity for a readable style which adds much to his treatment of a quite dry subject. The subject matter is mostly the lock and dock machinery of the British harbors, but both the Panama and Erie canals come in for a fair and adequate amount of space.

Addresses on Railroad Consolidation

Three addresses on Railroad Consolidation, by John E. Oldham, of Merrill, Oldham & Co., Boston, Mass., have been printed in two pamphlets by the Investment Bankers' Association of America, of which Mr. Oldham was formerly a vice-president. The first address is entitled "A Plan for Railroad Consolidations Including a Discussion of Their Purpose and Practicability," and includes 13 folding regional maps. The other two addresses, which make up the second pamphlet, are entitled "The Place of the New England Railroads in the Plan for Railroad Consolidations."

Bibliography and Primer on City Zoning

The Department of Commerce, through its Division of Building and Housing, Washington, D. C., has published a quite extensive Bibliography on City Zoning compiled by Theodora Kimball, Librarian, the Harvard School of Landscape Architecture; also A Zoning Primer, compiled by its Advisory Committee on Zoning.

Lining Tunnels Under Traffic

Plant and methods employed in lining a number of railway tunnels without interrupting traffic are described in a 45-page report in the 1921 proceedings of the American Railway Bridge & Building Association (Secretary, C. A. Lichty, Chicago). The lining in most cases was concrete placed by hand or by the pneumatic method.

Flat Slab Investigation Report Reprinted

The notable report entitled "Moments and Stresses in Slabs" prepared by H. M. Westergaard and W. A. Slater for the American Concrete Institute and published in the Proceedings of that Institute, vol. 17, 1921, has been reprinted by the National Research Council, 1701 Massachusetts Ave., Washington, D. C. ($1.)

PUBLICATIONS RECEIVED

THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT—Reprints of articles describing (1) plant at Woodstock, Ont., by W. G. Ure, in *Canadian Engineer*, Aug. 4, 1921. (2) Gastonia, N. C., by Fred W. Simonds, in *Public Works*, March 4, 1922. Rochester, N. Y.: General Filtration Co., Inc. Paper; 6 x 9 in.; pp. 16; illustrated.

COMMERCIAL LIBRARIES AND THE DEPARTMENT OF COMMERCE—A Report to Herbert C. Hoover, Secretary of Commerce, by the Committee on Co-operation with the Department of Commerce, H. H. B. Meyer, Chairman. Edited by Dorsey W. Hyde, Jr., President Special Libraries Association. Washington, D. C. Paper; 5 x 8 in.; pp. 23.

Outlines work of Committee of Special Libraries Association to secure co-operation with Department of Commerce on increasing usefulness of business libraries and of the publications of the department, as suggested by Secretary Hoover through F. M. Feiker, assistant secretary to Mr. Hoover.

CONCRETE-ALKALI INVESTIGATIONS IN MINNESOTA, 1919-20—By the Minnesota Department of Drainage and Waters in Co-operation with the U. S. Bureau of Public Roads. Address **E. V. Villard**, State Commissioner of Drainage and Waters, St. Paul, Minn. Paper; 6 x 9 in.; pp. 74; folding map, diagrams and half tones; many tables.

Studies in various counties in southwestern Minnesota and Iowa, including water and soil analyses, and examinations of concrete and clay drains. Disintegration found where salts in drain water exceeded 1,500 p.p.m. Contains also results of physical tests of concrete tile.

DER PRAKTISCHE EISENHOCHBAU—Von Alfred Gregor, Oberingenieur Bei Breest & Co. Berlin: Herman Meusser. Cloth; 8 x 11 in.; pp. 462.

DESCRIPTIVE GEOMETRY—By George Young, Jr., Professor of Architecture, Cornell University, and Hubert Eugene Baxter, Assistant Professor of Architecture, Cornell University. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 310.

THE DESIGN AND CONSTRUCTION OF DAMS—Including Masonry, Earth, Rock-Fill, Timber, and Steel Structures and the Principal Types of Movable Dams. By Edward Wegmann, C. E., M. Am. Soc. C. E., M. Am. Water-Works Assoc. Seventh Edition enlarged and revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 9 x 12 in.; pp. 555; illustrated. $10 (50s. net.)

DIE STANDSICHERHEIT DER MASTEN UND WANDE IM ERDREICH—V on Dr.-Ing. Heinrich Dorr, Professor Am Staatstechnikum in Karlsruhe. Berlin: Wilhelm Ernst & Son. Paper; 7 x 10 in.; pp. 56; illustrated.

Aims to present a simple or practical method of calculating masts or poles, and also walls, that are so anchored in the earth as to be safe from overturning. Relatively simple mathematics are used.

FACTS AND FIGURES OF THE AUTOMOBILE INDUSTRY, 1922—National Automobile Chamber of Commerce, 366 Madison Ave., New York City. Paper; 6 x 9 in.; pp. 96; illustrated.

Gives 1921 figures on production of passenger cars and motor trucks, curves of motor vehicle registration and highway expenditures by years since 1910, tables showing ratio of motor vehicles to population by states, and digest of state laws governing motor vehicle regulation in respect to size, weight and registration fees.

FOURTEENTH ANNUAL REPORT OF THE BOARD OF SUPERVISING ENGINEERS, CHICAGO TRACTION: Covering the fiscal year ended Jan. 31, 1921. Cloth; 6 x 9 in.; pp. 116.

HEALTH PROBLEMS INVOLVED IN NOISE AND FATIGUE—By Prof. Henry J. Spooner, M. I. Mech. E., F. G. S., etc. Member of the International Committee on Industrial Fatigue, London, England. Reprinted from the *Nation's Health*, February and March, 1922. Chicago: The Modern Hospital Publishing Co. Paper; 9 x 12 in.; pp. 9.

STANDARD SPECIFICATION FOR STEEL RAILWAY BRIDGES—Canadian Engineering Standards Association, Ottawa, Ont. Stiff paper; 6 x 9 in.; pp. 78; illustrated. 25c.

A revision of the specification by the same association, published two years ago (see these columns, Dec. 16, 1920, p. 1199), which was based on a specification published by the Canadian Society of Civil Engineers in 1912. In the present edition, movable bridges is withheld for separate publication; a section on erection has been added; paints and painting have been more fully treated; and other changes and additions have been made. The preface states that "it has been possible to modify certain clauses so as to bring them into substantial agreement with the corresponding requirements of the American Railroad Engineering Association."

UBER DIE FESTIGKEITSBERECHNUNG VON SCHIEBETOREN UNE AHNLICHEN BAUWERKEN—Von Dr. Ing. Adolf Eggenschwyler, Dipl. Ingenieur. Leipzig: H. A. Ludwig Degener. Paper; 6 x 10 in.; pp. 148.

A study of the design of various types of sliding gates used in hydraulic work.

WORLD METRIC STANDARDIZATION: An Urgent Issue—A Volume of Testimony Urging World-Wide Adoption of the Metric Units of Weights and Measures—Meter-Liter-Gram. Compiled by Audrey Drury, in Collaboration with Clifton Hildebrand, W. Mortimer Crocker, Harry Allcock, M. I. E. E., and other members of the World Metric Standardization Council. San Francisco: World Metric Standardization Council, 681 Market St. Cloth; 6 x 9 in.; pp. 524. $5.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Possibilities in Rural Engineering

Sir—On behalf of the American Society of Agricultural Engineers I want to assure you that we appreciate the constructive editorial, "Possibilities in Rural Engineering," appearing in the May 11, 1922, issue of *Engineering News-Record*.

Your picture of the possibilities in this field is not overdrawn in the least. It is constructive effort of this sort that will direct to agricultural engineering the attention that it merits. Engineers should interest themselves in the possibilities in this field, because they are unlimited. Agriculture has been slow to adopt modern engineering methods and equipment, but engineering is bound to do for agriculture what it has done for manufacturing and transportation, though the process will be somewhat slower. Unless the younger generation of farmers trained largely in our state agricultural colleges apply modern business methods and engineering on a much more extensive scale to farming than has been done in the past, the time is coming when we are going to see corporation farming or the consolidation of farms into single business units and operated like our factories or groups of factories are operated at the present time. There is a great need for the application of the principles of efficiency engineering and scientific management to the business of farming, and it will be the engineer pretty largely who will revolutionize this, the most important industry, as well as the most fundamental.

RAYMOND OLNEY,
Secretary, American Society of Agricultural Engineers.
St. Joseph, Mich., June 5.

Foundation Pressures in Multiple-Arch Dams

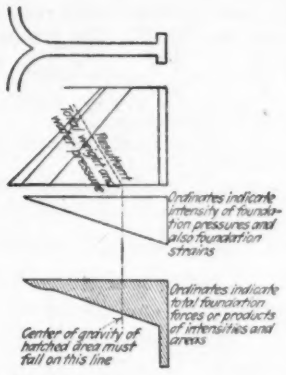
Sir—I have read the letter printed in *Engineering News-Record* of April 13 by "Enquirer" relative to the foundation pressures in a multiple-arch dam. Several years ago the writer raised practically this same question in a discussion of L. R. Jorgenson's article "Multiple-Arch Dams on Rush Creek, California," published in Transactions, American Society of Civil Engineers (Vol. LXXXI, p. 850), but no answer resulted from the author of that article.

As pointed out by "Enquirer," different assumptions will give variations of over 100 per cent in the foundation pressures. Such variation is hardly permissible in a structure in which all the active loads are determinable or at least are assumed within very narrow limits.

Though exception may be taken to the method of design advocated by "Enquirer" on the ground that the formula $f = \frac{P}{A} \pm \frac{Mc}{I}$ assumes the foundation on elastic material with strains proportional to stresses, it is probably the most reasonable assumption to make in the absence of more definite data.

For the purpose of getting the foundation pressures it is reasonable to assume one entire buttress and two half arches acting as a unit and the above formula may be applied if no tension results. If tension results, the formula becomes inapplicable and resort must be had to cut and try methods. The resulting foundation pressures would then be such as to satisfy the two conditions shown in the accompanying sketch on the assumption that no appreciable tension can exist between the structure and the foundation. For sections above the foundation, tension may exist to the extent of a portion of the weight below the section. For sections considerably above the foundation the above formula again becomes applicable, provided provision is made to take such tension.

If no pressure, or very light pressures, result under the


Resultant of weight and pressure
Ordinates indicate intensity of foundation pressures and also foundation strains
Ordinates indicate total foundation forces or products of intensities and areas
Center of gravity of hatched area must fall on this line

arch barrel, considerable shearing and bending stresses may occur in the arch and buttress. The shearing stress may run from 40 to 70 lb. per square inch, requiring the use of large quantities of reinforcing steel in the lower upstream portions of the buttresses. It may also be necessary to provide steel to take care of tension stresses due to bending. In many cases it will undoubtedly be found cheaper to extend the buttresses further downstream. This will equalize the foundation pressure resulting in more uniform foundation settlement (if not on rock foundation), and will avoid any large shearing and bending stresses.

Dams are structures of too great menace to be designed in the rather haphazard way that some buildings are designed. Yet the writer feels that some dams that have been designed and built in the past ten years have not received the careful and rational analysis of stress conditions which their importance demands. Some of the designs are only qualitative rather than quantitative, the principal theory of design being simply the words "arch action."

It is hoped that "Enquirer's" question will produce sufficient discussion to settle the points brought up.

San Francisco, Cal., May 26. L. H. NISHKIAN, Consulting Engineer.

Sir—In *Engineering News-Record*, April 13, p. 623, an engineer signed "Enquirer" desires information on the method of calculating the foundation pressures in a multiple-arch dam, or in any other structure of irregular foundation area.

"Enquirer" is no doubt correct if he assumes that in a multiple-arch dam, the arches and buttresses are acting together as a monolithic structure, particularly if the junction of arches and buttresses is heavily reinforced. Any movement of appreciable size between arches and buttresses naturally would produce a crack and leakage might occur.

The difference between the results for the maximum pressure at the foundation of the 80 ft. high buttress (8 tons per square foot by the "middle third" theory, and 19 tons per square foot by the method used by "Enquirer" is rather startling and needs, no doubt, further investigation.

The application of the general formula for eccentric loading (compression combined with bending) $f = P/A \pm Mc/I$, as suggested by "Enquirer" is correct in the general form. However, the moment of inertia, I, is to be calculated for the neutral axis of the area under stress, and not for the axis through the center of gravity of the foundation area, which "Enquirer" apparently has done.

The writer has given the general solution of the problem under consideration in his recent paper "Gravity and Arch Action in Curved Dams," (Transactions, Am. Soc. C. E. Vol. LXXXIV, (1921) p. 44.) The formulas derived in this paper were shown with regard to finding the foundation pressures for irregular foundation areas, such as occur, for instance, in the case of curved dams. The same equations ("cylinder hoof" or "monolith" theory) will also furnish correct results for the stresses in any horizontal section through a multiple-arch dam, by considering arches and buttresses as acting together monolithically.

It would lead too far to give here again the whole derivation of the formulas of the "monolith" theory. However, for ready reference the final equations are given below and the various steps for calculating the "monolith" pressures, with reference to the accompanying figure, which corresponds to the one shown by "Enquirer," are as follows:

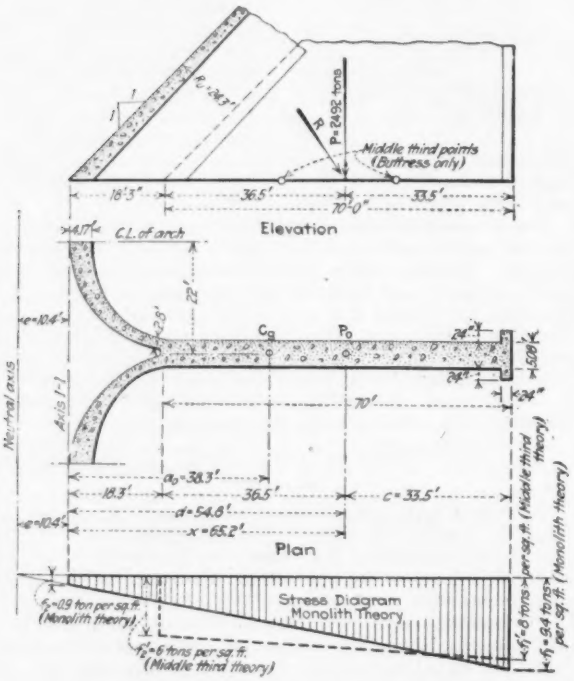
(1) Combine all the loads (water pressure and weight of dam, etc.,) which act above the horizontal section to be investigated, and find the point of intersection of the resultant R with the section. This furnishes the distances, c, and

d, of P_o from the downstream and upstream ends respectively, of the "monolith" above the section. The vertical component of R, may be called P.

(2) Figure the area A of the section, (arches plus buttress, etc.) and its center of gravity, C_g, also the distance a_o of C_g from the up-stream end of the section.

(3) Calculate the moment of inertia I_1 of the area A with regard to the upstream tangent *1—1*.

(4) Calculate the static moment S_1 of the area A with regard to the axis *1—1*.



(5) Figure the distance e, of the neutral axis from the axis *1—1* by the equation

$$e = \frac{I_1 - d\,S_1}{S_1 + A\,(d - 2a_1)}$$

Then, the disance x of P_o from the neutral axis is $x = d + e$.

(6) Calculate the section modulus S of the area A from the relation $S = S_1 + Ae$ and find the maximum compression stress f_1 at the downstream end of the buttress by the equation

$$f_1 = \frac{P(e+X)}{S} \text{ tons per square foot.}$$

The pressure at the upstream side, f_2, is proportional to the distance from the neutral axis. All dimensions are in feet and the weights in tons.

It should be noted, that this method of calculating the pressures is no more reliable if tension occurs at the upstream side (e negative), which for practical designs ought to be excluded anyway.

The writer would have been pleased to investigate as an example the dam referred to by "Enquirer." However, only the foundation area is shown by his figure, and neither the size and direction of the resultant, nor its point of intersection with the base are given.

These quantities nevertheless, may be estimated approximately. Thus, it was mentioned, that according to the "middle-third" theory the pressure at the toe was about 8 tons per square foot, and 6 tons at the heel. The average pressure is therefore 7 tons. The area of the rectangular foundation (buttress only) is $5.08 \times 70 = 356$ sq.ft. and, consequently, the vertical component of the resultant appears to be about $7 \times 356 = 2{,}492$ tons. From the condition that the pressure at the toe and the heel were 8 tons and 6 tons, respectively, it can be calculated that the resultant intersects the base about 10.1 ft. from the lower middle-third point, that is, about 1.5 ft. downstream from the center of the base.

Assuming this to be approximately correct, the conditions are represented by the accompanying figure.

By applying the equations of the monolith theory, referred to previously, there is,

$P = 2{,}492$ tons.

$A = 540$ sq.ft. (arches plus buttress plus counterforts.)
(A was estimated from figure.)

$c = 33.5$ ft.
$d = 54.8$ ft.
$a_o = 38.3$ ft.
$I_1 = 1{,}222{,}000$
$S_1 = 20{,}640$

The moment of inertia I_1 of the area A with regard to the axis *1—1*, is easily calculated, for instance, by dividing A into a number of small parts, whence I_1 equals approximately the sum of such parts multiplied by the square of the distances of the centers of gravity of the respective parts from the axis *1—1*.

In a similar manner S_1 is found by summation of the products of such small parts and the distance of the respective centers of gravity from the axis *1—1*.

Then

$$e = \frac{1{,}222{,}000 - 54.8 \times 20{,}640}{20{,}640 + 540\,(54.8 - 2 \times 38.3)} = 10.4\ ft.$$

$x = 54.8 + 10.4 = 65.2$ ft.

$S = 20{,}640 + 540 \times 10.4 = 26{,}150.$

$$f_1 = \frac{2492\,(33.5 + 65.2)}{26{,}150} = 9.4 \text{ tons per sq.ft.}$$

$f_2 = 0.9$ tons per square foot (taken from stress diagram.)

The corresponding results by the middle-third theory are 8 and 6 tons per sq.ft. at the downstream and upstream face of the buttress respectively. The values were plotted on the stress diagram of the accompanying figure whereby the shaded diagram shows the stresses as obtained by the monolith theory, and the dotted lines give the stresses calculated by the method of the middle-third theory.

Thus it is seen that a difference of nearly 20 per cent exists between the values of the maximum stresses as calculated by the two methods. The difference is still more marked at higher elevations, since the area of the buttress decreases rapidly, while the area of the arches decreases rather slowly. However, the conditions are not quite as serious as the calculations of "Enquirer" appeared to indicate.

It is further of interest to note that the neutral axis is considerably outside the area of the base, and that therefore a large increase of load would have to occur before any tension would develop at the upstream side.

FRED A. NOETZLI,
Chief Engineer, Beckman & Linden Eng. Corp.
San Francisco, Cal., April 24.

Yellow Fire Hydrants in Philadelphia

After much study Philadelphia is making a trial of yellow paint on its fire hydrants in place of the dark green or brown color heretofore used. Yellow was adopted after consultation by the Water Bureau with representatives of the fire and police departments, automobilists, teamsters and others. It was concluded that yellow would be satisfactory because it can be seen easily at night and in fog or rainy weather. It was also concluded that yellow would be sufficiently conspicuous to be seen by drivers of automobiles and motor trucks, thus reducing the number of breaks in fire hydrants by these machines, there being an average of a hydrant a day broken by motor driven and other vehicles.

NEWS OF THE WEEK

New York, June 15, 1922

Ford Muscle Shoals Offer Wins Committee Favor

Majority of House Military Affairs Committee Favors Proposal—Minority Groups Dissent

(Washington Correspondence)

The recommendations of a majority of the members of the Committee on Military Affairs of the House of Representatives in the matter of the Henry Ford proposal for the Muscle Shoals property of the government are embodied in a bill introduced June 5 by Representative McKenzie, the acting chairman of the committee. The title of the bill reads "To authorize and direct the Secretary of War to sell to Henry Ford Nitrate Plant No. 1 at Sheffield, Ala.; Nitrate Plant No. 2 at Muscle Shoals, Ala.; Waco quarry, near Russellville, Ala.; and to lease to the corporation to be incorporated by him dam numbered two and dam numbered three, including power stations when constructed as provided herein, and for other purposes."

The McKenzie bill recommends the acceptance of Henry Ford's offer, as revised on May 31, less the steam plant at Gorgas and with a provision that the "company shall be obligated during the lease period to manufacture nitrogen and other commercial fertilizers, mixed or unmixed, with or without filler, according to demand . . . The annual production of these fertilizers shall have the nitrogen content of at least 40,000 tons of fixed nitrogen." A profit of 8 per cent is allowed.

A majority of eight members of the committee favors the unqualified acceptance of Mr. Ford's offer as amended on May 31, and will submit its bill later. A minority of two is opposed to the Ford offer both as made and amended.

Two other bills already have been introduced proposing the acceptance of the Ford offer. One was introduced by Representative Wright, of Georgia, and the other by Representative Almon, of Alabama.

Dinner for Smith and Merriman

A dinner has been arranged to be held at the Hotel Pennsylvania, New York City, June 27, at 7:30 p.m., to give friends and associates of J. Waldo Smith and Thaddeus Merriman an opportunity to express their appreciation of the 17 years service of the former as chief engineer of the New York City Board of Water Supply and to celebrate the promotion of the latter to the post of chief engineer. The committee on arrangements consists of Robert Ridgway, chairman, and Jules Brouchaud, William W. Brush, William L. Chapman, John H. Cook, Clarence A. Crane, Walter J. Drummond, Alfred D. Flinn, John F. Galvin, Walter E. Spear, W. J. Buhrendorf, John P. Hogan, Clifford M. Holland, Nelson P. Lewis, James F. Sanborn, Merritt H. Smith, and Arthur S. Tuttle.

American Association of Engineers Convention Passes Stabilizing Measures

Dues Unchanged—Supreme Court Established—Employment Service Extended—Radical Amendments Rejected

(Engineering News-Record Staff Report)

MORE than 100 delegates bearing 40 proxies made up the official gathering of the American Association of Engineers, June 5, 6 and 7 at Salt Lake City. Two sessions were taken up in consideration of resolutions and constitutional amendments, some of which would have radically changed the organization machinery and in the opinion of many led to disintegration. The positive vote in favor of a stable, unified organization was particularly noted in the rejection of proposed amendments to establish departments for special groups and to form district compensation and minimum salary-fixing committees. Dues remain as at present except that the $3 fee for students was reduced to $1. Distribution of dues is changed so that chapters collecting their own dues and maintaining paid assistants in accordance with rules formulated by the board are to retain 60 per cent as they do now while those which do not maintain these functions will get but 40 per cent. Dues of all members are now collectable April 1. Heretofore they fell due on the anniversary of affiliation.

Perhaps the most stabilizing amendment passed related to the formation of a judiciary committee which will act as a supreme court in the hearing of all cases, especially those involving ethics. It will be the final court following a review of a case by the existing practice committee.

An extended, national employment service was authorized to be worked out by the board of directors as soon as finances will permit.

Support was given (1) a bill in Congress praying for relief to the Hawaiian labor shortage, (2) the Sterling federal employees reclassification bill and (3) the Smith-McNary revolving-fund land-reclamation bill.

Chapters were urged by resolution to induce members to join civic societies and to seek appointment on committees relating to engineering.

Entertainment of the delegates included a full-day trip by automobile over paved roads to the Strawberry Reclamation Project, the Olmstead hydro-electric development and the Utah Lake pumping station. The Ogden Chapter drove the delegates from Ogden to Salt Lake after an inspection of the newly completed road through Ogden Canyon on the way to the city well-water system in an upper mountain valley. By special dispensation of the Mormon church the delegates were permitted to examine the 60-year old perfectly-preserved roof trusses of the tabernacle which has an inside width of 150 ft. and length of 250 ft.

Society Functioning

The address of the outgoing president, H. O. Garman, reflected the keynote of the convention's prime action—retention of moderation in the form of administration. Though the swing from a strong centralized government to local-chapter control with its accompanying large distribution of funds had been all but disastrous, Mr. Garman expressed the opinion that the experiment had been worth the cost, as the association had profited by the harmful effects of both extremes. Now, he asserted, all are willing to settle on a middle ground, allocating to local chapters matters of local importance, and giving to headquarters national problems.

Mr. Garman's recommendations for the greater development and service of the association are as follows:

1. National headquarters must furnish the inspiration and leadership.
2. These ideas must be carried to the chapters by programs of publicity and traveling secretaries.
3. Dues should not be lowered and a larger portion should go to head-

Many Attend Springfield City Planning Conference

(Engineering News-Record Staff Report)

Many city and consulting engineers were among the two hundred-odd persons who attended the fourteenth National Conference on City Planning, at Springfield, Mass., June 5 to 7. The program was notable for its few and well chosen topics and the full utilization of the ample time afforded for discussion. Besides the papers, several of which are abstracted elsewhere in this issue, discussions on zoning were carried on at table during breakfast, lunch and dinner each day.

Lawson Purdy and Flavell Shurtleff were re-elected as president and secretary of the conference. The 1923 meeting will be held at Baltimore, Md.

Portland Cement Association Meeting at Atlantic City

At the same time that the American Society for Testing Materials is meeting in Atlantic City, the Portland Cement Association is to have a regular meeting, not at the same hotel, but at the Hotel Traymore. On June 27 there will be papers of general interest to engineers, namely, "Steel and Iron and Their Application in the Cement Industry" by W. R. Shimer, of the Bethlehem Steel Co., and "Quality Control in Cement Manufacture" by Richard K. Meade, a consulting engineer of Baltimore.

quarters to be used to stimulate and rejuvenate chapters.

4. Headquarters should care for federal legislation and administration and the chapters attend to state, county and municipal affairs.

5. A self-supporting employment service should be developed with offices located where there are large concentrations of engineers.

These features were accepted later as the report of the executive committee.

Committee Reports

Finances — Financial affairs of the association were reflected in the report of the treasurer, H. W. Clausen. Of an income of $218,176.84, the chapters received $113,067.98; *Professional Engineer*, $25,422.96; and headquarters $90,107.81, leaving a deficit of $10,421.75. The net worth of the association dropped from $43,000 to $33,000 during the year. The auditing committee reported the net worth of the chapters as more than $22,000 as of Dec. 31, 1921. He recommended a freer hand be given to the board of directors as changes come faster than can be met by annual convention by-laws or constitutional procedure.

Secretary's Report—The present condition of the organization was summed up by the secretary, C. E. Drayer. Three great needs exist: Seasoned leaders, statement of a program in such definite terms as to revitalize to action officers and members and establishment of a flesh-and-blood contact between all units of the organization. Of the 22,253 members on the roll May 15, 27.4 per cent were in arrears, for more than the constitutional limit of 90 days. During the year more than 3,100 members qualified for membership. Coincident with recent improved business conditions collections have improved. Departmental service has been crippled because of lack of funds.

Practice — The practice committee, headed by H. W. Clausen, has passed on 40 cases, 20 during the past year. It acts as a superior court but for the ultimate machinery in corrective measures a supreme court far removed from engineering policies is needed. An amendment was passed meeting this recommendation.

Chapter Activities — The committee on chapter activities, A. K. McDaniels, chairman, is organized with a personnel picked from the various districts and co-operates with the director. Advice and assistance in carrying on activities are given by personal contact. The principles followed are to give every member work to do and to encourage interest in civic affairs.

Employment — One in three members of the association has applied for positions during the past year. Data concerning address changes showed that, as an average, every engineer changes his address once in two years. K. H. Talbot, chairman of the employment committee, recommended that $1 of the dues be alloted to employment service. More than 1,100 men were placed by the chapters and 1,629 by headquarters. Several chapter representatives stated that not all placements had been reported. Oregon placed more than 370 men but had not reported to headquarters. By resolution the board was authorized to organize the employment service to give the best service possible with the funds available.

Political Activities — The committee on political activities, Harold Almert, chairman, recommended that representative engineers in each of the 12 districts get acquainted with their congressmen before the necessity arose of appearing before them in regard to legislative matters. That no active part be taken in presidential campaigns other than to interview all candidates urging that engineers be appointed to engineering positions was a recommendation approved.

Classification of Engineering Schools —Tentative minimum requirements for a "recognized technical engineering school" were brought in but no action was taken. The committee was continued. It was proposed that 15 standard units of preparatory high school work be required for entrance, and 12 quarters of 12 weeks each and attendance for 6,000 hours for graduation.

Proposed Educational Department— The committee on an educational department was continued and ordered to prepare specifications for engineering positions, outlining how preparation may be made to fill the positions.

Practice and Fees — Little support has been found among practising engineers by the committee on practice and fees for a more complete analysis of fee charges but there has been a demand for a brief report covering important features of practice which can be printed on a single sheet to inclose in a letter to prospective clients. Langdon Pearse, chairman, reported a schedule that had been adjusted to a simple basis with the purpose of supplying a minimum fee.

Legislation — Dan W. Patton, chairman of the committee on legislation, reported 19 states with license laws functioning reasonably well with but two or three exceptions. His recommendation to reduce the present association model law to a set of principles from which bills could be written to fit local requirements was adopted.

Chapter Functioning

Chapter functioning from fourteen different angles, handled by as many delegates, was the subject of a helpful session presided over by A. K. McDaniels. Some of the points made were as follows:

The principles of chapter success were set forth as being human interest, combat, life and service. More tangibly, said G. R. Fansett, "get contact with other civic organizations, set new members to work, select broadgage officials, crucify the man who uses the organization from selfish motives and control publicity by referring all matter to a second or third party for censorship and impressions."

On standard constitutions it was suggested that provision be made for removal of non-functioning officers. W. S. Boyle reported the novel experience of a successful operation for five years of the Indianapolis Chapter with no constitution or by-laws. Everybody is responsible; officials have no legal obligations.

Mr. Boyle detailed the workings of an engineer's program of local civic responsibility wherein eleven committees report on as many subjects among which are sewage, flood protection, street lighting, traffic arteries, street parking, local transportation, smoke protection, water softening and building code. A word of caution to keep out of the field of other organizations was given.

Chapter bulletins and news letters of varied forms were in evidence from the small four-page loose-leaf sheets for insertion in pocket size note books to the 16-page standard magazine size such as the *Pacific Engineer* issued at San Francisco for a group of seven chapters, 1,500 copies of which cost $150. The sheets must have, said A. J. Capron of San Francisco, a broad, tolerant, non-technical, editorial policy; and be attractive, dignified and brief.

Will P. Blair, Cleveland, asserted that the constitution should include the fact that the organization promotes and encourages engineering efficiency. Such expression would go a long way, in his opinion, toward combating the suspicions of employees and of the casually informed engineer that selfishness was the only tenet of the association. By resolution the board was asked to embody the idea in a constitutional amendment next year.

Publicity and Public Affairs

On publicity and public affairs W. W. De Berard, Western Editor, *Engineering News-Record*, indicated that a broad knowledge of public affairs was the basis of a successful democracy, and that the engineer's responsibility was larger than he realized because of the dominant part engineering plays in modern civic life.

At this point the Ogden chapter was awarded the publicity banner for having secured the greatest number of column inches of space (1,599) in the newspapers during the year. M. D. Williams, president of the Ogden chapter, in accepting the award outlined the way in which the chapter had functioned in identifying itself on an equal footing with the Rotary, Kiwanis and similar organizations. A year ago an engineer in Ogden was a mechanic, today he is known as a technical man. No committees in which engineering is involved are named without including an engineer.

In conducting chapter meetings "satisfy the yearnings of individuality," said E. T. D. Meyers, of Richmond. In turn have every member preside at some meeting and urge him to take part at other times. W. A. Dungan, Chicago, explained the "Safety Valve" —an informal gathering where anyone may speak on any subject. At Mr. Meyers' suggestion a committee was authorized to seek an audience with the American Railway Engineering Association to explain the aims and efforts of A. A. E. in promoting loyalty and efficiency.

No cure save removal from office exists for neglectful non-functioning officers, said L. K. Sherman who suggested a headquarters receivership when necessary for revitalizing defunct or inactive chapters.

A. M. Knowles, New York, suggested the following to maintain member interest: Men should be made to understand obligations when they join; more information on work done should be given the membership.

In the opinion of most of the delegates the sphere of women in chapter activities is not in a women's auxiliary but in attendance at social func-

(*Continued on p. 1015*)

Many Subjects Considered by Federation Council

National and International Problems of Broad Scope Claim Attention of Executive Board

In addition to adopting the report of its committee on Registration of Engineers, as reported elsewhere in this issue, the Executive Board of the American Engineering Council of the Federated American Engineering Societies at its recent Pittsburgh meeting discussed several other matters of national and international scope. The employment service now maintained by the council in New York is to be turned over to the administration and control of the four founder societies, but the employment committee of the council is to continue its investigation as to the possibility of co-ordinating existing and local employment services with a national service.

The committee on Regional Activities reported progress toward a general plan for the affiliation of local or state organizations and recommended that whenever an investigation is to be conducted under the auspices of the council involving local investigation in a community that contains a society affiliated with the federation, the services of that society are to be utilized.

Water Power Problems

Plans were announced proposing solutions for national water power and forestry problems and after a long discussion of the water-power problem the board decided to lay the entire question before President Harding. This action, it was stated, was prompted by "the Federal Water Power Commission's lack of effective and permanent personnel." A national movement toward conservation of forests in which would be co-ordinated the efforts of engineers, the U. S. Forestry Service, the forest services of the states, universities, and technical schools, and other groups such as the farmers, the railroads, and lumberman is to be in charge of a reforestation committee of the council. President Cooley of the Council is to confer with Will H. Hays with a view to enlisting motion-picture co-operation for this movement.

The Board pledged its support to President Harding in his plan of government reorganization, and in the event that that plan is not adopted, determined to press independently a movement for the establishment of a Department of Public Works.

The council's committee on Work Periods in Continuous Industries reported progress in its investigation into the relative merits of three 8-hour shifts and two 12-hour shifts. The report was referred to the committee on Procedure, which will direct the work of preparing it for publication and report at the next meeting of the board. It was reported that progress is being made in an investigation to determine methods of converting steel plants, as to their engineering aspects, from two to three shifts. The program of Frank A. Vanderlip, the New York banker, for reconstruction in Europe was brought before the board and referred to the committee on Procedure.

The board decided to co-operate with other agencies in finding a solution of the national problem of flood control involving the establishment of a national hydraulic laboratory. Co-operation is to be continued with the several organizations interested in the types of government contracts and a study was directed looking to a form of universal contract agreement for railroad construction. Plans were considered also looking to the expansion of the development of electrical energy.

It developed at the board meeting that committees are at work on the general policy of affiliation of American engineers with the engineering bodies of other nations. A movement headed by Sir Robert Hadfield is said to be on foot in London to form a union of engineers which shall include all English-speaking peoples.

Progress was reported as to the study of the business cycle with the assistance of 150 engineering groups and in co-operation with the Department of Commerce. The data gathered in this work are being compiled in Washington where they will be available to further the plans of the President's Committee on Unemployment in a study of cyclical depressions.

Other subjects considered by the board were jurisdictional awards in labor, patent legislation, an international engineering congress, aerial research, engineering representation on the Civil Service Commission, foreign relations, and wasted in the agricultural industry.

The Engineer in Public Life

FRANKLIN THOMAS

Following the adoption of a charter provision for a city-manager form of government, Franklin Thomas, professor of civil engineering at the California Institute of Technology, was elected a member and vice-chairman of the Board of Directors of the City of Pasadena, Cal. His public activities also include membership on the City Planning Commission, and this year he was chosen first vice-president of the Pasadena Chamber of Commerce.

Prof. Thomas was born in Red Oak, Iowa, in 1885 and was graduated from the University of Iowa in 1908, after which he spent a year as a graduate student at McGill University. After several years on railroad work, beginning on the C., B. & Q., he became construction foreman for E. A. Wallberg, contractor, of Montreal, on a 10,000-hp. hydro-electric plant. For two years he served as instructor, department of engineering, at the University of Michigan and left that position to become designer for the Alabama Power Co. at Birmingham on the Muscle Shoals development. He returned to university work in 1913, becoming a professor of civil engineering at Throop Institute, recently renamed the California Institute of Technology. Prof. Thomas' work has included flood control and hydrographic investigations.

Apply for More Power at Niagara

American Superpower Corp. Seeks Preliminary Permit for 12,000 Sec.-Ft.

The American Superpower Corp. has applied to the Federal Power Commission for a preliminary permit covering the use of 12,000 sec.-ft. or one-half the additional diversion of water in the Niagara river recommended by the Board of Engineers. The application was filed with the understanding that no action be taken on it until the additional diversion may have been arranged. It is thought that the application was made solely for legal purposes in connection with the existing controversy between the federal government and the state of New York in the matter of the waterpower act.

Construction Proposed

The application proposes the construction of a transmission line from Lewiston, in Niagara county, to Yonkers, where connection will be made with lines supplying New York city. The estimated cost is $27,457,000. The power canal from La Salle to Lewiston is to be made available for water transportation and, in addition, a waterway is to be made possible "from the upper Niagara river to the lower Niagara river, the state of New York having granted this route to applicant in order that private interests might be induced to accomplish the construction of a ship canal on the American side around Niagara Falls, for which both the state and federal governments have made frequent surveys, but without undertaking such project."

The applicant estimates that $34,188,000 will be required for the construction of the works necessary for the generation of 450,000 hp., under a head of 301 ft. at 88 per cent efficiency. The power house would be equipped with nine units of 50,000 hp. each, to be stepped up to 110,000 volts for local distribution and to 220,000 volts for transmission to New York. The power taken from the line at intermediate points would be stepped down to the required voltage. The transmission line to New York would consist of four circuits, each capable of carrying 75,000 kilowatts at 220,000 volts, three-phase at 60 cycles. There would be two independent lines on a right-of-way 350 ft. wide.

Publications on Subways and Engineers in War Available

There is still available for distribution a limited supply of the following publications noted in this journal March 9, p. 920; "American Engineers Behind the Battle Lines in France" (98 pages, 9 x 12 in.) a collection of articles by *Engineering News-Record's* correspondent with the A. E. F. during the war; and "Building Subways in New York," (78 pages, 9 x 12 in.) a series of articles by Fred Lavis.

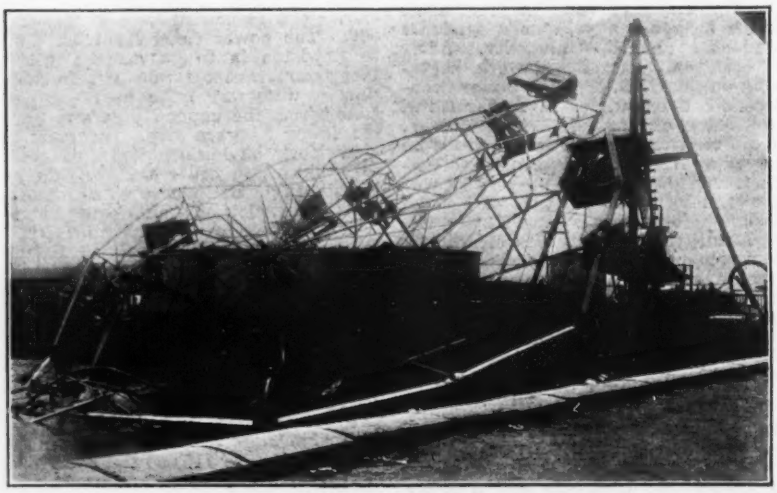
Both publications are illustrated and are bound in stiff-board covers with cloth back. They will be mailed to *Engineering News-Record* readers on receipt of 25 cents per copy to cover postage and handling charges

Ferris Wheel Blown Down; Seven Passengers Killed

Squall of 90 to 100 Miles Velocity Overturns Supporting Tower

A violent squall on the afternoon of June 11 blew down a small Ferris wheel at Clason Point Park, New York City. The sixteen cars of the wheel were filled with passengers, some 60 or 70 in all, and seven of these were killed or fatally injured. The accident was caused by the overturning of the leeward trunnion-support tower by the wind pressure; the wheel itself shows no indication of failure and was only little distorted in the fall.

Extensive destruction was wrought by the same squall at other points along Long Island Sound, in upper New York City and in northeastern New Jersey. Throughout the general storm area, extending over the eastern part of New York State and New England, squalls and gales with intense rainfall occurred at many points; trees and buildings were blown down and local floods occurred.



WRECKED CLASON POINT FERRIS WHEEL; LOOKING SOUTHWEST

The Clason Point wheel, built in 1910, was a combination steel and wood wheel of 63-ft. diameter journaled on a 6-in. steel shaft in bearing blocks bolted on pyramidal wooden towers about 40 ft. high. The plans for the structure were drawn by L. F. J. Weiher and A. L. B. Evrolas, architects, New York City. The wheel consisted of two side frames about 7 ft apart connected by the center shaft and the shafts from which the cars were hung. Each comprised a segmental rim built up of 4 x 8¾-in. sticks sawed to the circle and spliced with steel plates, 16 spokes of 3 x 2½ x ⅜ tees, two intermediate rings of 1¾-in. tees, and thin diagonal sway rods in the transverse plane of each spoke. Each of the two towers, which were 12 ft. apart, was built of a three-post inner frame having a 10 x 12 plumb post and 8 x 8 batter posts reaching out 19 ft., and an 8 x 8 back-leg with about the same reach, all resting on 10 x 12 sills and anchored to small concrete piers under the main posts.

After the wrecking of the wheel it was found that the west or landward tower was undisturbed and its trunnion bearing block and cap were still in place, while the east tower was down to the east, to which side the wheel had also been blown. In the view herewith, looking southwest, the near edge is the top of the wheel, while the far or higher edge was the lower side before the wheel was blown down; the shaft end showing at the level of the roof of the house-boat was the west end, seated in the bearing on the undisturbed west tower in the background.

According to P. J. Reville, superintendent of buildings for Bronx Borough, New York City, who has jurisdiction over the Clason Point region, the wheel was inspected a month ago, as part of his bureau's regular spring inspection of amusement structures. It was reported in good condition. Examination since the failure has not shown specific defects and the broken sticks of the overturned east tower are not decayed, he states; some of the concrete anchor blocks are lifted and tilted, however, including the pier under the back leg of the surviving west tower.

Estimates of the overturning forces, based on a 25-lb. wind pressure in the squall and an exposed area of 600 to 800 sq.ft., indicate an overturning moment at the base of the leeward tower sufficient to produce a compression of about 40,000 lb. in the back-leg and a corresponding tension in the front leg. The sufficiency of the structure to resist high wind pressure is under investigation.

Wind velocities ranging from 60 to 100 m.p.h. are reported for the squall. The New York station of the U. S. Weather Bureau recorded a maximum 5-min. movement of 75 m.p.h., and the observatory in Central Park, about 6 mi. farther north and at much lower height above ground, 42 m.p.h. At Mount Vernon, Dr. J. W. Redway, cooperative observer of the Weather Bureau, recorded a 5-min. movement of 70 m.p.h., but estimates the maximum at 90 m.p.h. or more, corresponding to a pressure of about 30 lb. per sq. ft. At his station an abrupt jump of the barometer occurred during the squall, amounting to 1-5 in. within half a minute or less.

Am. Soc. C. E. Casts First Ballot for Official Nominees

The first ballot for official nominees of the Am. Soc. C. E. was canvassed June 1. Eliminating those who received less than 5 per cent of the votes cast, under the constitution of the society, the following are eligible for consideration in the second ballot which will be canvassed Aug. 15. The vote received by each candidate in the first ballot is noted after his name.

For president: C. F. Loweth, 1,423; John F. Coleman, 294; Andrew M. Hunt, 258.

For vice-president, Zone 2: George S. Davison, 322; R. Khuen, Jr., 93; S. T. Wagner, 58; John F. Coleman, 54; C. P. Fortney, 49; W. M. Gardner, 49; L. L. Hidinger, 44.

For vice-president, Zone 3: Anson Marston, 402; Charles H. Paul, 51.

For director, District 3: G. G. Honness, 28; Glenn D. Holmes, 23; Charles A. Poole, 21; Bruce L. Cushing, 17.

For director, District 5: E. B. Whitman, 75; H. K. Bishop, 13.

For director, District 7: George H. Fenkell, 162.

For director, District 8: A. S. Baldwin, 159.

For director, District 9: R. N. Begien, 73; James Moreland Johnson, 19; Charles H. Paul, 7.

For director, District 12: J. C. Ralston, 49; George C. Mason, 40; Eugene Carroll, 17.

Expect Further Railroad Wage Cut

News dispatches from Chicago foreshadow further railroad wage reductions by the Railroad Labor Board amounting to $40,000,000 and affecting 355,000 additional railway employees. These will include clerks, signal men, marine employees, coal passers, oilers, water tankers, freight handlers, and other common labor included in the station employee group.

Carpenters Barred by Building Unions Despite Gompers' Plea

The Building Trades Department of the American Federation of Labor has rejected a proposal by Samuel Gompers that steps be taken to reunite the Brotherhood of Carpenters and Joiners with the other building trades unions in the department. The building trades convention endorsed the National Board for Jurisdictional Awards which was responsible for the decision against the carpenters that led to their withdrawal from the department a year ago.

A.G.C. to Issue $400,000 5 Per Cent Certificates

In order to insure the carrying forward of its program of development, the executive board of the Associated General Contractors of America has authorized the issuance of $400,000 worth of 5 per cent interest bearing certificates, interest being payable semi-annually—June 1 and December 1. The certificates are to be retired within five years, will be issued in denominations of $100 and $500 and will constitute a prior lien on the dues and assets of the A.G.C. The sale of certificates will be handled by the executive board, advisory board and president's council of the A.G.C.

A. A. E. Convention

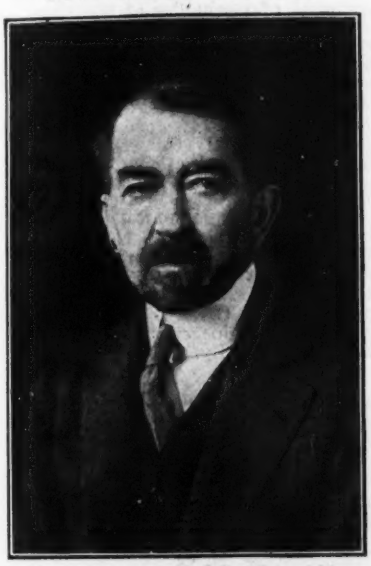
(*Concluded from p. 1012*)

tions and outings. An understanding of the organization by the women promotes attendance, it was found.

The incoming president, A. N. Johnson, summed up the aims of the organization as follows:

"Until the formation of the A. A. E., the engineering profession as a whole was represented by no single organization, the welfare of the individual was a matter for individual concern, the engineer's responsibility to his profession was unstressed, that of his profession to the public welfare unrealized. To supply these fundamental needs has been, and will continue to be, the motive that actuates the association.

New President of A. A. E.



A. N. JOHNSON

"Never before has the association been confronted with a greater opportunity to render service. Each member must be imbued with the spirit of service to his fellows and to his community, for in no other way can the individual benefit by the association, or the association be of benefit to the profession."

Because of the singleness of purpose of employment between A. A. E. and the Federated American Engineering Societies there should be little difficulty in working out a plan of mutual benefit, asserted Mr. Johnson. Both cooperation in university extension work and the promotion of public undertakings A. A. E. is peculiarly well organized to foster is his belief. "It must be the constant endeavor on the part of those charged with the guidance of the policies of the association," he continued, "to let no opportunity escape to join in every effort that makes for the greater usefulness of our profession. The day of petty jealousies has passed. Let us keep ever before us our ideals, to make the engineer of greater worth to himself and his profession that we may make its contribution towards the common good the greatest of all professions."

Professor Rockwell, of Tufts, To Be Rutgers Engineering Dean

After almost twenty years connection with the faculty of the engineering school of Tufts College, Mass., Prof. Edward H. Rockwell will leave in June to accept the position of dean of engineering at Rutgers College, New Brunswick, N. J. During the past four years Prof. Rockwell has been head of the department of civil and structural engineering at Tufts.

Professor Rockwell was graduated from Worcester Polytechnic Institute in 1890 with the degree of B.S., receiving a degree of C.E. from that institution last year. For twelve years prior to his going to Tufts, he was engaged in practice of civil engineering in Chicago, Worcester and Boston. Besides his professional duties, he has acted as consulting engineer on state, county and private work. He was elected instructor of civil engineering at Tufts in 1902, assistant professor in 1903 and professor of structural engineering in 1906. In 1918, he was placed in charge of both the civil and structural engineering departments.

He is a member and past president of the Boston Chapter of the American Association of Engineers, a member of the council of the Society for the Promotion of Engineering Education, a member of the American Society of Civil Engineers, of the American Association of University Professors and of the Council of the Affiliated Technical Societies of Boston.

Increasing interest in engineering at Rutgers has caused that college to call upon Professor Rockwell to carry forward its plans.

Would Investigate Diversion of Lake Michigan Water

(*Washington Correspondence*)

An exhaustive investigation of the whole question of the diversion of water from Lake Michigan was assured, it is believed, when the Committee on Rivers and Harbors reported favorably on May 23 on the resolution requesting the Secretary of War to furnish facts as to the effect of the diversion upon the depths of the harbors and channels of the Great Lakes and as to the damage that will result by the discharge of the waters, after they have been polluted by the sewage of Chicago, through the Illinois River. The committee calls the attention of the House to the fact that the channel of the Illinois River is insufficient to receive the volume of water which it is proposed to pass through it. Information is requested also as to the effect of the project upon the lands adjacent to the Illinois River and the health of the people living near that stream.

Vote Money for Chicago Bridges

Bond issues of $3,400,000 for bridges and viaducts and $2,000,000 for extension of the street lighting system were approved by the voters of Chicago on June 5. The bridge bonds are mainly for the completion of the Madison St. bridge and Roosevelt Road bridge and viaduct. Work on these structures has been stopped for some time owing to lack of funds, leaving them in such condition as to obstruct and inconvenience traffic seriously.

Congress Approves 3-Year Federal Road Program

Annual Appropriations of $50,000,000 Provided—Creation of Deficit is Authorized

(*Washington Correspondence*)

State highway officials and all others directly interested in highway construction seem to be pleased with the highway legislation which now has been approved by each House of Congress. The fact that the conferees provided for a three-year program carrying $50,000,000 annually, increased the maximum of federal contribution, and gave the Secretary of Agriculture the right to make contracts prior to the actual appropriation of next year's funds, more than offsets the reduction of $15,000,000 in the appropriation for the next fiscal year.

There is some fear that a maximum of $16,250 per mile for the federal contribution will discourage the construction of certain roads particularly in mountainous or swampy sections where construction is difficult. With the increasing need for wider and thicker surfacing, the opinion of most federal and state highway officials is that the maximum should be raised instead of lowered.

There are 14 states that will have used up their federal-aid allotments at varying times during the course of the fiscal year beginning July 1. To meet that situation without the actual appropriation of funds the conferees established a precedent by authorizing the Secretary of Agriculture to create a deficit by obligating the federal government to meet payments on road contracts when the money is available. Under this arrangement, the $50,000,000 authorized for the fiscal year beginning July 1, will not have to be appropriated until near the close of that year.

Authorizes Barge Line Between St. Louis and New Orleans

After a thorough study of the situation, the Secretary of War has authorized Edward F. Goltra, of St. Louis, to operate a barge line between St. Louis and New Orleans on the Mississippi River. For several years the Government has been conducing an experiment in transportation on the Mississippi and Warrior Rivers. The Secretary of War is anxious that nothing interfere with the working out of that experiment, but finally gave the necessary permission to Mr. Goltra in the belief that there is ample tonnage to support both lines.

Chevalier Promoted to Colonel in Engineer Reserve

Willard T. Chevalier, who served with the 11th Engineers in France during the World War, with rank of captain, major and lieutenant-colonel, has been commissioned colonel in the Officers Reserve Corps. Col. Chevalier, who joined the staff of *Engineering News-Record* as associate editor early this year, becomes commanding officer of the 363rd Reserve Engineers, succeeding Col. William Barclay Parsons, promoted to the position of deputy chief engineer of G. H. Q. Engineer Headquarters.

New Engineering Building for Michigan Students

The Michigan Alumnus announces that plans have been approved and contracts prepared for the new engineering shops and laboratory for the University of Michigan. This building, for which approximately $750,000 has been appropriated, will be approximately 190 x 223 ft.

The building was designed by Smith, Hinchman & Grylls, Detroit architects.

Plan New Series of Road Tests at Pittsburg, Cal.

The California Highway Commission, jointly with the U. S. Bureau of Public Roads, and with the co-operation of the Columbia Steel Co. in the use of its property, is to continue to completion the Pittsburg highway tests started last spring by the company to investigate the strength of different types of concrete highways, with particular reference to the effect of reinforcing steel. At the conclusion of the tests already instituted, the commission and the federal bureau expect to start an entirely new series of tests on the same ground, which has been offered for the purpose by the steel company.

Brick Used for First Time on State Highway in Indiana

Contract for the construction of the first brick road in Indiana to be built under the direction of the state highway department was recently let at a cost of $219,916.78. Indiana was one of the last states in the union to establish a highway department, and while many miles of brick roads have been constructed in the past by the various counties, the contract just let is the first action of this kind by the state.

The section to be paved with brick is 6.897 miles long and extends from Putnamville to a point 1½ miles east of Mt. Meridian. It is a part of the old National Road which runs entirely across the state, and is the principal traffic route between Indianapolis and Terre Haute.

Decision of the state highway department to use vitrified brick on this road is in accordance with the recent announcement by Gov. W. T. McCray that brick roads would be included in this year's program. The bid for brick is $111,916.78 more than the low bid for concrete on this section. The design calls for a 5-in. concrete base, 3-in. vertical-fiber brick and asphalt filler. The work will be done by the Carpenter Construction Co., of Terre Haute.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the Bureau of Public Roads.

Junior Civil Engineer, $1,200 a year.

Junior Highway Bridge Engineer, $1,200 to $1,600 a year.

Examination June 21.

Highway Bridge Engineer, $1,800 to $2,100.

Applications to close June 27.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

The Seattle branches of the American Society of Civil Engineers and the American Association of Engineers listened recently to a discussion upon scientific methods of making concrete delivered by Prof. Durf A. Abrams of the Lewis Institute, Chicago. Prof. Abrams is making a tour of the western states.

PERSONAL NOTES

JOHN R. VAN SICKLE, for the past five years associate professor of civil engineering at the Mississippi Agriculture and Mechanical College, resigned June 1 to take up work as designer for the Virginia Bridge & Iron Co., Roanoke, Va.

ROBERT S. PARSONS, since 1920 general manager of the Erie R.R., has been elected vice-president in charge of operations of that company.

L. D. BLAUVELT, consulting engineer, Denver, Col., has been appointed chief engineer of the Moffat Tunnel Commission which is to carry out the public project for a six-mile railway tunnel in Colorado, as described in *Engineering News-Record* of May 18, p. 836.

C. M. HATHAWAY, district engineer of the Illinois State Division of Highways, has been appointed engineer of construction to succeed B. H. Piepmeier, resigned to become state highway engineer of Missouri.

F. S. ALTMAN has been appointed district engineer for the Portland Cement Association with headquarters at Minneapolis, Minn. Mr. Altman has been with the Portland Cement Association as engineer of the Kansas territory since his return from France where he served as captain in the 23rd Engineers. Before the war Mr. Altman was city engineer of Atchison, Kansas.

E. R. SHEPARD, who has been prominently connected with the electrolysis work of the U. S. Bureau of Standards, has resigned to continue the same line of work independently at Washington, D. C.

CHARLES ENZIAN has opened a consulting engineering office in Philadelphia where he will engage in general consulting engineering practice, specializing in examinations, analyses and reports of undeveloped and developed coal properties for operating companies, financiers and land owners.

FRANCIS A. DEVER, assistant engineer for the Duluth, Missabe & Northern R.R., has been awarded the Strathcona Memorial Fellowship in transportation at Yale University for the next academic year. Mr. Dever was graduated from the college of engineering and architecture, University of Minnesota, in 1920.

PROF. JACOB O. JONES, who has been associate professor in the department of mechanics at the University of Kansas, has accepted the position of associate professor of hydraulics in the college of engineering and architecture of the University of Minnesota. In addition to regular instruction work, Prof. Jones will devote special attention to research and laboratory investigations in experimental hydraulics.

W. R. KETTENRING, office engineer of the Chicago & Northwestern Ry., has been appointed auditor of capital expenditures to succeed the late A. S. Morris. Mr. Kettenring is a graduate of Cornell College, Iowa, and has been in the engineering department of the C. & N. W. Ry. since 1902.

STANLEY H. WRIGHT, who has been associated for a number of years with J. W. Ledoux, consulting engineer, Philadelphia, has joined the engineering staff of the Gilbert C. White Co., consulting engineers, Durham, N. C. Mr. Wright will be engaged in the design and construction of waterworks and his headquarters will be at Hendersonville, N. C.

PROF. ARTHUR J. WOOD, until recently professor of railway mechanical engineering, Pennsylvania State College, has been appointed head of the department of mechanical engineering to succeed Prof. E. A. Fessenden who has gone to Rensselaer Polytechnic Institute. Prof. Wood has been in the department of mechanical engineering in the Pennsylvania State College since 1904. Recently he has had direct charge of the engineering experiment station.

HENRY P. CAMPBELL, senior assistant city engineer of Indianapolis, resigned recently to enter a private engineering firm. He was appointed at the beginning of the present city administration. In addition to his work as assistant to John L. Elliott, city engineer, he also was in charge of track-elevation work. The board of public works accepted the resignation, which became effective June 10, and named MELNOTT N. BEEBE, street engineer, to fill the place, at the same time promoting WILLIAM LACEY, an assistant engineer, to the position of street engineer. Both Mr. Beebe and Mr. Lacey have been in the department for several years. Mr. Lacey's old place will not be filled at the present time.

C. G. TROWBRIDGE, former city engineer of Decatur, Ga., has resigned to engage in engineering work with a local investment company.

BUSINESS NOTES

HORACE M. BRINGHURST, former sales engineer for the General Iron Works Co., Cincinnati, Ohio, has been made sales engineer in the Kansas City office of the Paul J. Kalman Co., Inc., Chicago, Ill., fabricators of reinforcing steel.

THE MARCK ENGINEERING & CONTRACTING COMPANY, an organization which has for the past three years been operating in the West Indies with offices at Santo Domingo, has opened offices in Brooklyn, N. Y. The company expects to facilitate movement of American materials and machinery for work in Latin America through the addition of its Brooklyn office.

JOHN M. BAILEY, who for more than twenty years has been secretary of the Pittsburgh Testing Laboratory, has been elected vice-president and secretary of the Standard Inspection Co., a building-inspection organization with offices in Pittsburgh. Previous to his association with the Pittsburgh Testing Laboratory Mr. Bailey was with the Burden Iron Works, Troy, N. Y., and the Portland Rolling Mill Co., Portland, Me.

THE AIR REDUCTION SALES CO., handling welding and cutting apparatus and supplies, announces the following change in personnel: A. R. Ludlow, former vice-president in charge of sales, is now first vice-president; M. W. Randall, former secretary, is vice-president and secretary; Herman Van Fleet, former chief engineer, is now vice-president and operating manager; Dr. F. J. Metzger is vice-president in charge of research and development.

THOMAS B. HUDSON has resigned his position with the Whiting-Turner Construction Co., Baltimore, Md., and has opened offices in Baltimore and Washington, where he will represent the McFarland-Meade Co. of Philadelphia, manufacturers of steel sash, fireproof doors and windows, ornamental steel stairs and sheet-metal products.

J. M. KRYL, president of the Kryl Bridge and Crane Works, Chicago, and W. H. EICHELMAN, until recently chief engineer of the Hamler Boiler & Tank Co., have established a partnership for the fabrication of steel. The location of the new firm is Chicago.

THE NEW JERSEY CONCRETE PRODUCTS CORP., announces the acquisition of the factory of the Pre-Cast Concrete Co. near Dover, N. J., and the extension of its own facilities to supply in addition to pre-cast structural concrete and ornamental stone, other concrete products such as building tile, face and common brick, etc. The factory of the corporation is in Dover, N. J., and its executive office in New York City.

JOHN F. SCHURCH has been elected a vice-president of Manning, Maxwell & Moore, Inc., and has taken charge of the company's western sales. His headquarters will be in the company's Chicago office. Mr. Schurch was graduated from the University of Minnesota in 1893 and since his graduation has held successive positions with the Minneapolis, St. Paul & Sault Ste Marie R.R., the Railway Materials Co. of Chicago, and with the T. H. Symington Co. as vice-president.

OBITUARY

CHARLES A. WILLARD, building contractor, died at his home in Long Beach, Cal., May 2, age 62 years.

P. H. CONNOLLY, city engineer of Racine, Wis., died at his home in that city recently. Mr. Connolly was a graduate of the University of Wisconsin and a member of the Engineering Society of Wisconsin, the Western Society of Engineers, and the American Society for Municipal Improvement.

ALVIN E. GRAVELLE, civil engineer, Los Angeles, Cal., died April 28. As engineer with the Wisconsin Bridge & Iron Co. about 1900 he designed the fixed-trunnion bascule bridge over the Milwaukee River at Grand Ave., Milwaukee, Wis. (*Engineering News*, July 3 and 31, 1902, pp. 19 and 81). Later he was associated with John Geist, consulting engineer, at Milwaukee, in the design of the Broadway bascule bridge over the same river. He then went to the American Bridge Co., leaving a few years later to become assistant bridge engineer at Cleveland, Ohio.

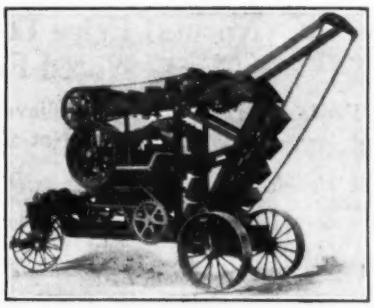
COL. RICARD O'SULLIVAN BURKE, for many years engineer of harbor work for the city of Chicago, died May 11 at the age of 84. He was born in Ireland in 1838 and came to this country in 1857. He served in the U. S. Army during the Civil War, becoming a captain of engineers and being mustered out with the rank of colonel. In 1887 he entered the engineering department of Chicago, being in charge of water-pipe extensions. Later he became superintendent of sewers for about two years, but then returned to the engineering department as engineer in charge of harbor work, which position he held until his retirement in 1917. Col. Burke was a member of the Western Society of Engineers.

EQUIPMENT AND MATERIALS

Cast Steel Portable Rock Crusher

A new portable rock crushing plant for road builders has been produced by the Universal Crusher Co., Cedar Rapids, Iowa. The shell of the crusher is cast steel, making a stronger and considerably lighter machine than the former cast-iron equipment. With a 15x36-in. crusher opening the new plant weighs 14,250 lb.

This outfit is made in all sizes for road work, the crusher openings ranging from 10x16 in. to 15x36 in. Another feature is the improved truck frame with double gooseneck made continuous with the I-beam sides and se-



curely trussed. The I-beams are 8 to 12 in., according to the size of the plant.

High Speed Locomotive Crane

Clutch design which simplifies the mechanism and permits quick operation is the special feature of a locomotive crane recently put on the market by the Moore Brothers Crane Co., Chicago. In the accompanying view this crane is shown handling a grab bucket but it is adapted also for use with a 1-yd. drag-line bucket. A patented gear-shift device enables one

clutch to do the work of three separate clutches, and this one clutch provides for swinging and propelling the machine and luffing the boom. The only other clutch used is for the drum. In this way a reduction in number of shafts, gears, levers and bearings is obtained. A 35-ft. V-shaped boom is used and the machine is mounted on traction wheels. Its weight is about 14 tons with tank and bunker empty.

Out-of-the-Ordinary Trade Publications

"How To Build a Better Home" is a handsome and useful pamphlet published by the COPPER AND BRASS RESEARCH ASSOCIATION, New York City. Besides pointing out the values of non-rusting metals for the home builder the pamphlet contains an instructive discussion, with pictures, of residence construction.

Nowhere perhaps will one find as good a technical discussion of slate as it is adapted to and used in electrical work as is furnished in a 40-page pamphlet entitled "Slate For Electrical Uses," published by the STRUCTURAL SLATE CO., Pen Argyl, Pa. The tabulations of the properties of slate are particularly useful.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Normal Price Level Illusory, Says Noted Economist

Professor Irving Fisher Believes Essence of Normality Is Price Stability, Not a Particular Level

A significant view of coming price conditions and their relation to past experience is expressed below by Irving Fisher, professor of political economy, Yale University, world famous as an authority on financial trends. His statement is a reply to the following letter addressed to him by the editor of "Business Side of Construction:"

"There is so much interest in what the "new normal" for prices should be that Engineering News-Record *would like to treat the matter in its Business Side of Construction. Your views will be most welcome and will help us reach a useful conclusion."*

"Since the war, prices have been compared with 1913 or 1914, and nearly all index numbers are based upon a pre-war year. Many are of the opinion that the new normal will be about 50 per cent above the 1913 price level. On the other hand not a few believe that the present 1913 base should be maintained, and that prices will gradually move down to it again over a period of years."

"Will there be a new normal? If so, what will it be?"

"In reply to yours of June 2 I would say that I think the 'new normal' for prices is a delusion and a snare. I have collected and charted all the index numbers of price movements from the earliest time, which I have been able to gather together. This history of prices shows that there never has been any 'normal.' The price level today in France is about thirty times what it was a thousand years ago, according to the somewhat shaky data which we have. We have good data, however, for England, beginning in 1782. Prices fell between 1782 and 1789, rose between 1889 and 1909, about doubling, fell between 1809 and 1849 (with many oscillations in between) to below what they were in 1789, rose between 1849 and 1873 about 50 per cent, fell between 1873 and 1896 about 25 per cent, rose between 1896 and 1914 about 35 per cent, rose much more rapidly between 1914 and 1920 to over three-fold, and have fallen about 50 per cent since that time. That is, throughout history the price level has constantly changed. Or, in other words, the purchasing power of the dollar or other monetary unit, has constantly changed in the inverse ratio. Exactly the same thing is true in the United States for the 120 years for which we have index numbers of prices."

"But there is always the illusion that a few years ago there was a "normal" which we want to reach again. This was true after the Civil War. It was true in the Bryan campaign in 1896 when the cry of Bryan and his followers was to give us back the "Dollar of the Daddies." Before the war the whole world was excited over the "High Cost of Living" which assumed that the price level was "abnormally high." There was vague talk about going back to the price level of ten years before. After the war it was natural to consider the war as the disturbing element and the pre-war price level as "normal." Hence the cry for "Back to Normalcy" and a deflated price level. Deflation has been partly accomplished, with the result of the most disastrous depression of trade the country has ever had. In every situation people look longingly back to the "good old times" of a few years before which they can remember. Recently the oscillations of prices have been so rapid that some people still look longingly back to the pre-war price level, while others look longingly back to the price level of 1920. The danger is that there will therefore be two parties, one for inflation and one for further deflation. As Reginald McKenna, formerly Chancellor of the Exchequer of Great Britain and now President of the London Joint City and Midland Bank, the largest bank in the world, has so well said there is not and never has been any normal and, in the long run, one normal is as good as another, while the constant effort to cure inflation by deflation and deflation by inflation threatens us with an alternation of evils, and both are equally bad. Central Europe is cursed with inflation just as England and the United States are cursed with deflation today. What we want is a stable price level and once we have got it, whether it is high or low, it should be regarded as "normal." This must be obtained by some kind of legislation similar either to such as I proposed in my "Stabilizing the Dollar" proposed, in accordance with that plan, in Congress by Representative Dallinger's bill of Massachusetts and by the bill of Representative Goldsborough of Maryland, or by the plan of Professor Cassel or any other plan that will work. Without some plan we are sure to continue oscillating. No one can do more than guess as to what the future holds in store. My own guess is that, in the immediate future, unless stabilization is achieved by appropriate legislation, we shall find prices rise for the next couple of years or so. After the peak has been reached and the credit extension again strained in the United States while gold is being drawn away to Europe there is a prospect of a long gruelling fall of prices. Beyond this I would not even try to guess."

"I hope I have made it clear that while I believe that one 'normal' is just as good as another, some normal is of vast importance. The essence of normality in the price level is not a particular level of prices but constancy. An inconstant price level plays havoc—rising prices, making all the evils associated with the phrase the 'high cost of living' and falling prices, all those associated with the phrase the 'depression of trade,' although several kinds of other evils besides 'high cost of living' and 'depression of trade' are involved. These alternations cost the world billions of dollars a year in waste motion, discontent and injustice and some day we must surely put a stop to them."

Cement Up in the West

The recent rise in cement prices at the Northampton, Pa., and Hudson, N. Y., mills has been followed by a similar advance in several of the production centers of the Middle West and at one in the South.

The rise, attributed to higher coal prices, amounts to 10c. per bbl. at the mills in Buffington, Ind., Universal, Pa., Steelton, Minn., and 15c. at Fordwick, Va.

The mill change is reflected in an increase of 19c. in Toledo, 20c. in Detroit, and 10c. per bbl., f.o.b. 12 other Mid-Western cities, including Chicago. New York quotations remain as reported last week.

Foreign Construction Being Done by New York Firms

Six more important foreign construction projects are here added to the list, as published in the *Engineering News-Record* on April 20, of New York contractors, all of whom are building in Central and South America. Total values of the contracts amount to $29,500,000, the two largest to Dwight P. Robinson & Co., Inc., for $15,000,000; and Ulen Constr. Corp., for $10,000,000. Following are details of jobs:

Name and Address Of Contractor New York City	Kind of Work	Where Work Is Located	Cost	When Started	Expected completion	Name of Owner
Stone & Webster 120 Bway.	Office Building	Buenos Ayres	$200,000	April, 1922	Feb., 1923	All American Cables Inc. New York City
Ulen Co., 120 Bway.	Railroad,including stations and terminals	Bolivia	10,000,000	Aug., 1921	1927	Bolivian Gov't.
Dwight P.Robinson & Co., Inc., 125 E. 46th St.	Embassy Building	Rio de Janeira, S. A.	300,000	Jan., 1922	Sept., 1922	U. S. Gov't.
Dwight P.Robinson & Co., Inc., 125 E. 46th St.	Irrigation work including 5 dams	Northeastern Brazil	15,000,000	1921	1925	Brazilian Gov't
R. W. Hebard & Co., Inc., 40 Rector St.	200 Kilometers of modern highway	Republic of Panama	4,000,000	April, 1921	1925	PanamanianGov't.
R. W. Hebard & Co., Inc., 40 Rector St.	Group of Concrete Buildings	Santa Elena. Ecuador	100,900	July, 1921	June, 1922	All American Cables Inc., New York City

Largest May Pub'ic Bond Sales Since 1892

Municipal bonds sold in May throughout the United States totaled $101,113,982, which is $36,000,000 less than in April, but nearly $38,000,000 heavier than in May, 1921. In fact, according to the *Commercial and Financial Chronicle*, this May's sales exceeded the May figures for the last thirty years.

Municipalities emitting permanent bonds numbered 587 during May, 1922, as against 339 for April, 1922, and 326 for May, 1921. The number of separate issues made during May, 1922, were 782 as compared with 697 for April, 1922, and 419 for May, 1921.

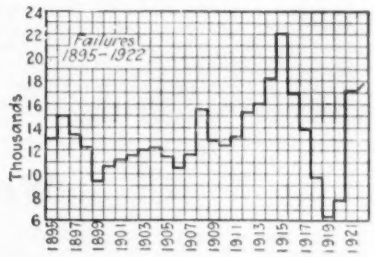
Among the more important new issues during May, 1922, were the following: Baltimore, $8,332,000 5s at 107.805, a basis of about 4.3 per cent; Boston, $4 223 000 4s at 100.71, a basis of about 3.95 per cent; Norfolk, Va., $3,165,000 5s at 103.569, a basis of about 4.56 per cent; Cleveland, O., $3,593,000 4½s at 103.13, a basis of about 4.38 per cent; Buffalo, N. Y., $2,230,000 4½s at 103.575, a basis of about 4.10 per cent and Columbus, O., $1,755,000 5s at 105.789, a basis of about 4.39 per cent.

The accompanying list of thirty-five representative issues shows thirty-two sold above par and three at par; the yields ranging from 4.20 to 5.23 per cent. The rates varied from 4½ to 6 per cent. All those drawing 6 per cent were west of the Mississippi, while the 4½s and 4½s were nearly all in the New England and Middle Atlantic states.

Failures Last Week and Since 1895

While the 440 failures reported for the week of June 10 show an increase over the 407 defaults for the previous week, that may be due, at least in part, to the fact that this week, without a holiday, contained one more business day than did last week. The present level, however, is much higher than last year, when only 300 failures were reported to R. G. Dun & Co. for the corresponding week.

The current week's failures involving $5,000 in each instance totaled 243, or a percentage of 55.2 of the aggregate number. Last week, with 244, or only one more default with liabilities over $5,000, the percentage was distinctly higher, being 60.0, while a year ago the corresponding figures were 167 insolvencies and 55.6 per cent.



Canada's total failures this week were 55, a decided decrease from the 70 of the previous week, but still higher than a year ago, when the total figure was 32. Of the current Canadian defaults, 29 had liabilities of $5,000 or more in each case, compared with 35 last week.

REPRESENTATIVE BOND SALES OF MAY AND JUNE, 1922

County	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased by
Butler, Mo.	Road	$300,000	.....	5	.....	102.86	.....	Kauffman, Smith, Emert & Co. and Wm. R. Compton Co., St. Louis, Mo.
Douglas, Minn.	Drainage	6,200	1937	6	5.23	108	May 1, 1922	Minneapolis Trust Co., Minneapolis, Minn.
Floyd, Ind.	Road	35,040	.....	5	.....	103.93	.....	Fletcher Savings & Trust Co., Indianapolis, Ind.
Hamilton, Ind.	Concrete road	48,000	.....	4½	.....	100	.....	Citizens State Bank of Noblesville.
Hancock, Ohio	Road	71,000	1923–32	5½	4.41	103.10	May 1, 1922	Prudden & Co., Toledo, Ohio.
Kosciusko, Ind.	Road	16,800	1923–32	5	4.65	101.98	Apr. 3, 1922	Meyer-Kiser Bank of Indianapolis, Ind.
Lac Qui Parle, Minn.	Ditch	166,600	1928–42	5½	.....	101.47	July 15, 1922	Minnesota Loan & Trust Co., Northwestern Trust Co. and Lane, Piper & Jaffray, Inc.
	Ditch	3,650	1923–32					
Little Rock Creek	Ditch	660,000	1925–60	6	.....	100	.....	The California Bank, Citizens Nat. Bank, Stevens, Page & Sterling, Sheldon & Lancaster, Ramsdell S. Lasher and John O. Knight & Co., all of Los Angeles.
Palmdale Irr. Dist.								
Los Angeles Co., Cal.								
Lyon, Nev.	Highway	41,500	1934	6	.....	101.27	Apr. 15, 1922	Palmer Bond & Mortgage Co., Salt Lake City.
Marion, Ind.	Track elevation	250,000	1923–37	5	4.21	105.86		
	Home	150,000	1923–37	5	4.30	104.70	May 25, 1922	Union Trust Co. of Indianapolis.
	Bridge	35,000	1923–32	5	4.29	103.42		
Montgomery, Ohio	Highway extension	17,500	1922–42	5½	4.948	102.42	May 1, 1922	A. C. Allyn & Co., Chicago.
		11,050	1923–32	5½	4.95	102.82		
New Castle, Del.	Highway	150,000	1926–36	4½	4.40	101.26	June 1, 1922	Guaranty Co. of New York.
	Bridge	55,000	1966–67	4½	4.40	101.26	June 1, 1922	
	Bridge	50,000	1938–44	4½	4.40	101.26	June 1, 1922	
Nobles, Minn.	Ditch	75,000	1928–42	4½	.....	101.36	June 1, 1922	Lane, Piper & Jaffray, Inc., and Drake, Ballard Co.
St. Joseph, Ind.	Highway	23,500	1923–32	5	4.62	101.90	May 15, 1922	J. F. Wild & Co., State Bank.
		25,000	1923–32	5	4.62	101.905	May 15, 1922	J. F. Wild & Co., State Bank.
		49,000	1923–32	5	4.61	101.93	May 15, 1922	Fletcher Savings & Trust Co.
		31,000	1923–32	5	4.62	101.91	May 15, 1922	Fletcher Savings & Trust Co.
Seneca, Ohio	Highway	45,000	1923–31	5½	.....	102.12	May 1, 1922	Breed, Elliott & Harrison, Cincinnati; Prudden & Co., Toledo.
		18,000	1923–31	5½	.....	102.12	June 1, 1922	
		81,000	1923–31	5½	5.17	102.63	June 1, 1922	Richards, Parish & Lamson.
Tippecanoe, Ind.	Highway	18,700	1923	5	4.60	101.99	Apr. 15, 1922	Fletcher Savings & Trust Co., Indianapolis, Ind.
Municipality								
Beaver, Pa.	Gen. improvement	$50,000	.....	5	.....	107.16	May 29, 1922	Ft. McIntosh Nat. Bank, Beaver, Pa.
Birmingham, Ala.	Pub. improvement	88,500	1932	5½	.....	102.14	June 1, 1922	Steiner Bros. & Co., Birmingham, Ala.
Cadillac, Mich.	Sewage disp.	65,000	1926–34	5	.....	100	July 1, 1922	Mrs. W. W. Mitchell, Cadillac, Mich.
Dearborn, Mich.	Street imp't.	55,000	1942	4½	4.48	100.25	June 1, 1922	First National Co., Dearborn, Mich.
Elmira, N. Y.	Pavement	400,000	1923–40	4½	.....	101.10	June 1, 1922	Clark, Williams & Co. and C. W. Whitis & Co.
	Sewer	200,000	1924–45					
	Pavement	50,000	1941					
Evansville, Ind.	Park	175,000	1924–29	5	4.69	101.91	Apr. 1, 1922	City National Bank, Evansville, Ind.
	Pub. impv't.	125,000	1924–29	5	4.68	101.97	Apr. 1, 1922	
	Waterworks	140,000	1924	5	4.42	104.18	June 1, 1922	
Grand Rapids, Minn.	Sewer	20,000	1937	5	4.99	100.01	Apr. 15, 1922	Kalman, Wood & Co., Minneapolis, Minn.
Harrisonburg, Va.	Water	150,000	1927–51	5	4.98	100.089	May 27, 1922	Wm. R. Compton Co. and Graham, Parsons & Co., New York City.
Indianapolis, Ind.	Highway connecting link	36,500	1932	5	.....	102.94	May 29, 1922	Meyer-Kiser Bank of Indianapolis, Ind.
Lima, Ohio	Intercepting and outfall sewer	563,000	1923–46	5	4.58	104.113	May 1, 1922	Taylor, Evart & Co. Inc.; A. B. Leach & Co. Inc.; Second Ward Securities Co. of Milwaukee.
Middletown, N. Y.	School	329,000	1924–60	4½	4.20	104.344	June 1, 1922	E. H. Rollins & Sons, New York City.
Milwaukee, Wis.	School	500,000	1942	5	4.36	105.041	Jan. 1, 1922	Eastman, Dillon & Co.; W. A. Harriman & Co., Inc.; Hornblower & Weeks; Keane, Higbie & Co. and Equitable Trust Co. all of New York City.
	Elec. lights	200,000	1942	5	4.36	105.041	Jan. 1, 1922	
	Park	350,000	1942	5	4.36	105.041	Jan. 1, 1922	
	Street	600,000	1942	5	4.36	105.041	Jan. 1, 1922	
	Bridge	600,000	1942	5	4.36	105.041	July 1, 1922	
	Harbor impr'v't.	500,000	1942	5	4.36	105.041	July 1, 1922	
	Sewer	300,000	1942	5	4.36	105.041	July 1, 1922	
New London, Conn.	Public impr'v't.	150,000	1923–37	4½	4.20	102.01	June 1, 1922	Winthrop Trust Co. of New London.
Niagara Falls, N. Y.	City Hall Bldg.	365,000	1937–53	4½	.....	101.67	June 1, 1922	Sherwood & Merrifield.
Omaha, Neb.	Street impr'v't.	60,000	1942	4½	4.45	100.69	June 1, 1922	National City Co., New York and Continental and Commercial Trust & Savings Bank of Chicago.
Portland, Ore.	Special impr'v't.	317,954	1932	6	.....	105.30@		
						105.40	May 26, 1922	Carl G. Liebe, $50,000.
						105.10		J. D. Leonard, $15,000.
						105.07@		
						105.32		Abe Tichner, $245,454.
						105.13		City Treasurer, $7,500.
Puyallup, Wash.	Water	75,000	.....	5½	.....	103.07	May 31, 1922	Hanchett Bond Co., Inc., Chicago, Ill.
Salem, N. J.	Waterworks	44,000	1923–44	5	4.73	102.28	June 15, 1922	B. J. Van Ingen & Co., New York.
Schenectady, N. Y.	Public impr'v't.	200,000	1923–32	4½	4.325	101.678	May 1, 1922	National City Co., New York.
	Sewers	100,000	1923–42					
	Public impr'v't.	15,000	1923–37					
	School	10,000	1923–32					

Freight Loadings Increase

Reports of the Car Service Division, American Railway Association, show that in the week ended May 20, 1922, 792,459 cars were loaded with revenue freight. This is 15,100 cars in excess of the loading in the previous week, and is the best record made in any week since April 1st. Compared with the preceding year, the total loading increased 21,468 cars. Comparison with the 1920 performance, however, shows a decrease of 69,615 cars.

SURPLUS AND SHORTAGE STATEMENT—MAY 15 TO 23, 1922

Districts	Flat Cars Surplus	Flat Cars Shortage	All Box Cars Surplus	All Box Cars Shortage	All Coal Cars Surplus	All Coal Cars Shortage	Total All Cars Surplus	Total All Cars Shortage
Eastern	847	...	12,577	...	72,606	...	90,448	...
Allegheny	472	...	10,895	...	101,311	...	116,279	...
Pocahontas	11	...	822	...	409	...	2,332	...
Southern	2,062	18	6,106	374	2,834	66	15,230	460
Northwestern	857	...	23,658	...	2,370	...	33,576	10
Central western	428	97	18,864	5	25,624	...	58,600	102
Southwestern	675	58	6,612	144	3,537	...	13,169	202
Total	5,352	173	79,534	523	208,691	66	329,634	774
Canadian roads	1,430	...	22,385	...	1,135	...	31,850	...
Grand total	6,782	173	101,919	523	209,826	66	361,484	774
May 15, 1922	6,511	86	108,865	252	219,766	449	377,764	816

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 1; the next, on July 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	+$2.68	$3.50	$4.00	$2.48	+$2.86	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb.	+3.60	4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	+2.58	3.50	3.50	2.38	+2.76	3.52½	2.55	3.60	+2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	48.80@49.80	+48.50	48.30	44.10	50.50	57.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.34	2.25	+2.07	+2.34	2.90	2.83	2.94	2.48
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.25	1.50
Sand, cu.yd	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	+2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	38.00	34 50	45.00	+40.00	+49 00	27.00	21.50	47.00
Lime, finishing, hydrated, ton	15.80@16.80	22.50	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.18	1.75	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	10.00	11.15	11.00	16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.075	.115	.0707	.082	.08	....	.12	.09
Hollow partition tile 4x12x12, per block	.1112	.0707	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	−.86	−.92	1.09	−.96	− .98	−1.10	1.04	.86	+1.07
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.10 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.13 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

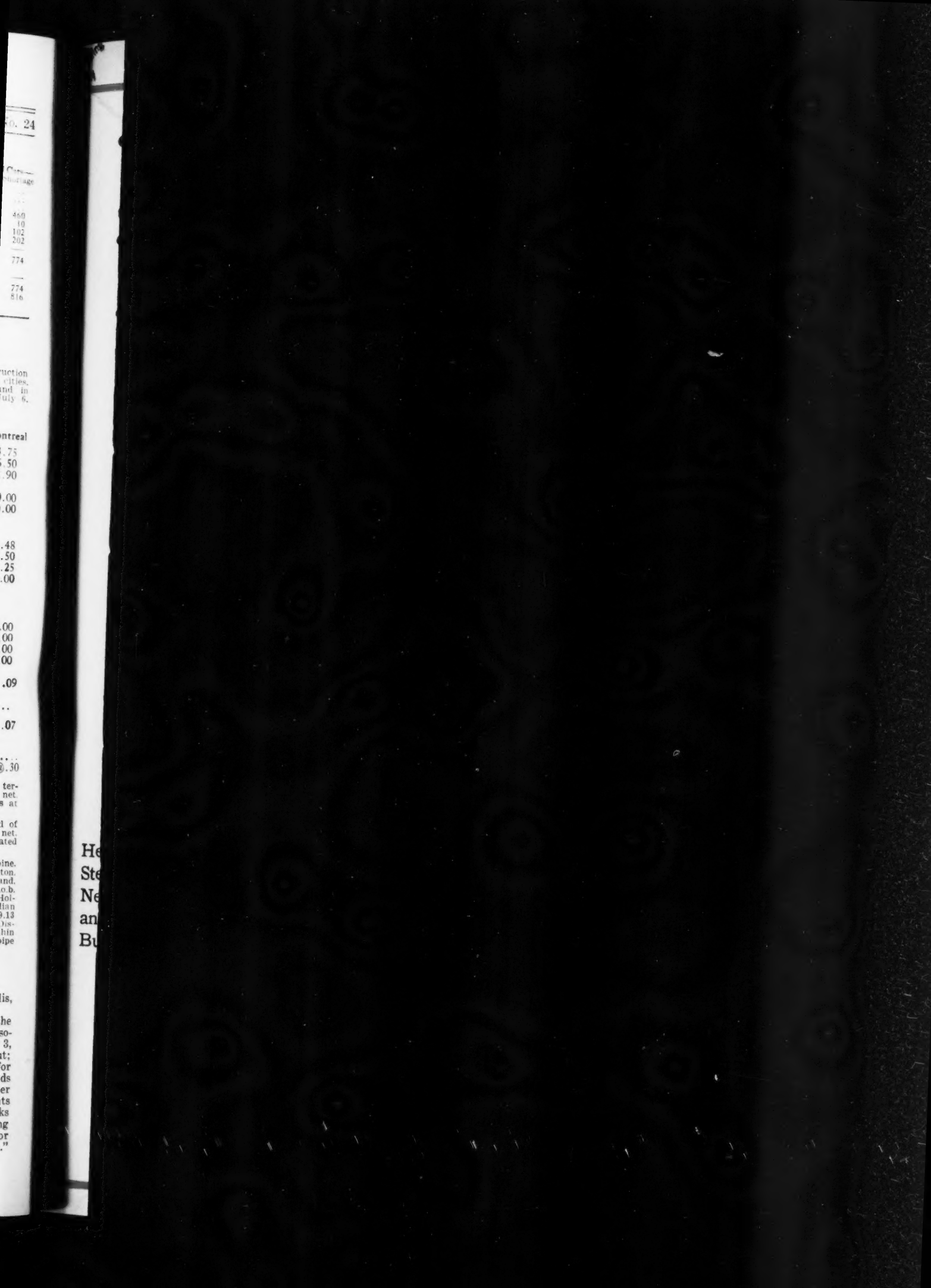
Linseed oil is the only material of the sixteen listed above to decline. Steel, lumber, and cement continue to stiffen. Cast-iron pipe is up $2.25 per ton in Atlanta, while crushed stone has risen sharply in Montreal.

Structural shapes quoted at $2.68 as against $2.58 in New York warehouses and at $2.86 as compared with $2.76 per 100 lb. in Minneapolis, one week ago. Structural rivets and reinforcing bars up 10c. in New York. Bars are also up in Minneapolis, and up 15c. in Montreal. Pittsburgh price of $1.60 per 100 lb. on steel shapes and reinforcing bars giving away to quotations of $1.70@$1.75, the higher figure applying principally to bars.

Cast-iron pipe quoted at $48.50 as against $46.25 per ton, f.o.b. Atlanta.

Cement up 10c. per bbl. in Chicago and Minneapolis, following advance at mills, as described elsewhere in this section. Crushed stone 40c. higher per ton in Montreal.

Douglas fir up $1 in Minneapolis, and heavily advanced in Denver.

Raw linseed oil down 2c. in New York, Atlanta, Chicago and Minneapolis, and 8c. per gal. in Denver.

A total of 380 mills reporting to the National Lumber Manufacturer's Association for the week ending June 3, shows 220,903,463 ft. of lumber cut; 230,351,754 ft. shipped and orders for 220,069,897 ft. b.m. Production stands at 5 per cent and orders at 2½ per cent below normal while shipments are just at normal. Lumber stocks are growing smaller at the mills owing to recent heavy demands, and the labor supply is reported only "fair" or "easy."